

# Dynamic Containment

January 2020



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# 1. System operability needs (1/2)

## Current system operability needs

Currently, the electricity system is experiencing lower inertia and larger, more numerous losses than ever before.

Faster acting frequency response products are needed because system frequency is moving away from 50Hz more rapidly as a consequence of imbalances. This is evident in the rate of change of frequency (RoCoF) and illustrated by the interaction of size of imbalance and inertia as show below:

$$\text{RoCoF} \left( \frac{\text{Hz}}{\text{s}} \right) = \frac{50}{2} \times \frac{\text{Imbalance (MW)}}{\text{Inertia (MVA.s)}}$$

As a system operator we need to manage both the absolute change in frequency and the RoCoF.

The variables we can control in the RoCoF equation are the size of imbalance (or losses) and the level of inertia.

- Managing low inertia is a key element of our 2025 zero carbon ambition. Our Stability pathfinder work is looking to create markets for inertia.
- The number of significant losses and their absolute size will increase as we welcome new interconnection and offshore wind onto our system.



# 1. System operability needs (2/2)

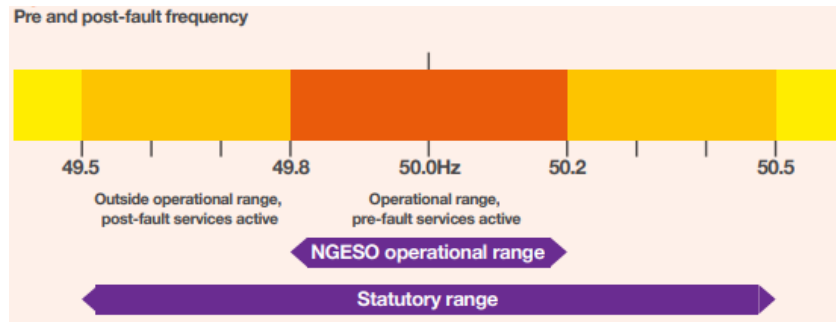
## How do we resolve this?

Over the next few years, the ESO aims to deliver a new suite of faster-acting frequency response services to support our operations as the electricity system is decarbonised and to ensure that these new services enable a level playing field for all technologies.

For more background see: [SNaPS](#) (2017), [FES](#) (2019), [OSR](#) (2020).

## For these new products, our design has considered some key principles:

- Fast acting  
Because - frequency moves more quickly in a low inertia system
- Separation of pre and post fault requirements  
Because - existing services can be eroded pre-fault
- Dynamic & proportional delivery  
Because - delivery of power should be related to the size and significance of the incident





## 2. Dynamic Containment (1/3)

This pack outlines the proposal of the service Dynamic Containment (DC).

We plan to release DC as the first of our new end-state services, in order to meet our most immediate need for faster-acting frequency response. We will design this service to operate post-fault, i.e. for deployment after a significant frequency deviation.

As part of the proposal, the following items have been suggested due to operability requirements:

### 1. GSP (Grid Supply Point)

Each participating unit must be identified by its GSP. Assets can be aggregated within a single GSP and each asset must measure frequency locally at their connecting point.

GSP group approximately maps the geographical area covered by the DNO license areas. This level of locational granularity is not enough to ensure secure network planning and operation therefore the requirements above have been proposed.

### 2. Settlement metering

We require greater granularity of data for performance monitoring and settlement. Settlement metering shall be provided at a rate of 20Hz. Each element of service delivery, lag time & delivery time, requires measurement at 10Hz for accurate settlement therefore the overall settlement metering must be 20Hz (i.e. 20 measurements per second).

Operational experience with Enhanced Frequency Response has informed our requirement for 20Hz settlement metering.



## 2. Dynamic Containment (2/3)

### 3. Performance monitoring

Performance monitoring processes and rules are required to be reinforced to ensure the system requirement is continuously met and NGENSO has better visibility of performance from service providers.

#### Principles

- A fault could happen at any time, so the service always has to be ready
- To value it, we need confidence in the ability of providers to fulfil the service
- An expectation of 100% performance at all times is unrealistic and unreasonable
- A mechanism to incentivise good performance is needed, allowing some deviation from 100%
- Significant underperformance can only be tolerated for very short durations
- Very slight underperformance can be tolerated for longer durations

### 4. Baseline

For NGENSO to value and utilise this service, providers must submit a baseline against which we can measure and monitor performance.

A baseline is a projection of expected output submitted in advance. Without this projection, it is impossible for NGENSO to fairly determine if changes in output are related to contracted services or are instead coincidental.



## 2. Dynamic Containment (3/3)

### 5. State of Energy

We expect energy-limited providers to be a significant market participant for all our future frequency response products.

Our principles for addressing the challenge of state of energy management for providers of frequency response services are:

- NGENSO will provide clear guidance on asset sizing and appropriate contract volume and provide clear rules on how a provider should maintain acceptable SoE
- If the guidance and rules are followed then the provider should not experience SoE issues, if they do then it will be because NGENSO has not managed frequency appropriately
- Unavailability for commercial reasons will not be permitted, only for technical reasons (e.g. plant failure)
- Providers must maintain service provision throughout the contracted period(s) - provision and SoE management must occur simultaneously

**Further information on these five areas will be provided later in the slide pack.**



## 3. Product design proposal (1/3)

### What is Dynamic Containment?

Dynamic Containment (DC) is a fast-acting post-fault service to contain frequency within the statutory range of  $\pm 0.5\text{Hz}$  in the event of a sudden demand or generation loss.

The service delivers very quickly & proportionally to frequency but is only active when frequency moves outside of operational limits ( $\pm 0.2\text{Hz}$ ).

### What volumes are we going to procure?

Eventually, but not immediately, we expect to procure up to 1GW of this product in both directions. Our procurement will grow with the available market and our own system readiness, expecting  $\sim 250\text{MW}$  initially.

### Is there a unit cap?

The unit cap is 50MW. We are eventually looking to have a diverse locational spread, so we are trying to encourage the right market behaviour for when locational mapping comes in.

### Is there a volume cap?

Currently, the volume cap is expected to be around 250MW. We expect this to increase to around 1000MW in the future. This is to promote competition and increase liquidity in the frequency response market, reducing our overall balancing costs and increasing value for the consumer.





## 3. Product design proposal (2/3)

### Can I stack DC with existing response and reserve?

DC cannot be stacked with existing response and reserve products, but we intend to allow stacking with new response and reserve products introduced in the future. Generally, we would like to maximise the stacking opportunities, but it is not allowed for the same MW/MWh to be sold twice.

### Is DC going to replace any response products?

Eventually yes. As we continue with the roll-out of our other new services, we will gradually procure less of the monthly-tendered FFR service, and our intention is to phase out the monthly tenders for FFR by Q4 2021/22. For further information, refer to the [‘Response and Reserve Roadmap’](#).

### How will DC interact with other new products?

DC has been designed to meet our operational needs in coordination with two other frequency response products: Dynamic Moderation (DM) and Dynamic Regulation (DR).



## 3. Product design proposal - Metering (3/3)

### Metering & frequency measurement rule

- Each individual asset within any aggregated unit must pass pre-qualification and testing at its own metering point.
- Each individual asset within the aggregated unit needs to measure their frequency locally at their connecting point.

### Operational & settlement metering

- NGENSO requires visibility of real-time active power. This shall be provided at a rate of 1Hz for each and every asset within a unit.
- We require greater granularity of data for performance monitoring and settlement. Settlement metering shall be provided at a rate of 20Hz.
- Each element of service delivery, lag time & delivery time, requires measurement at 10Hz for accurate settlement therefore the overall settlement metering must be 20Hz (i.e. 20 measurements per second).
- Operational experience with Enhanced Frequency Response has informed our requirement for 20Hz settlement metering

### Monitoring and measurement

Monitoring of system frequency must be to 0.01Hz maximum error. Monitoring of active power output must be to 1% maximum error under reference environmental and system voltage conditions.



## 4. Procurement proposal

Open to BM and Non-BM (non-discriminating)

	Day 1 (Q1 2020/21)	Future
<b>Platform</b>	Existing EPEX (Pay-as-clear)	Single platform for all markets
<b>Auction</b>	Weekly	Daily
<b>Products</b>	Bundle (HF+LF in same bid)	HF+LF procured separately
<b>Period</b>	EFA Block	There is potential for this to change e.g. Settlement Period
<b>Volume</b>	~250MW (cap 50MW)	~1000MW of both HF and LF
<b>Allow stacking?</b>	Not for current products on the market	Yes (there will be no rules excluding participation in other services, but the provider must always remain compliant with the obligations of the service)*

\*It is not allowed for the DC product to be stacked with existing response and reserve products, but we intend to allow stacking with new response and reserve products introduced in the future. With each new future product, we will make a specific statement whether and how the products will be included / stacked with other products. If no statement is made, it means the stacking is not allowed. Generally, we would like to maximise the stacking opportunities, but not allowed for same MW/MWh to be sold twice. e.g. a 20MW asset could sell 5MW for Product A, and 15MW for Product B in the same period. They can NOT sell 20MW for Product A and 20MW for Product B for the same period.



## 5. Baselines (1/2)

**For NGENSO to value and utilise this service, providers must submit a baseline against which we can measure and monitor performance.**

A baseline is a projection of expected output submitted in advance. Without this projection, it is impossible for NGENSO to fairly determine if changes in output are related to contracted services or are instead coincidental.

Rules for submission of baselines will follow existing precedents set in the Balancing Mechanism for submission of Physical Notifications (PNs).

- Gate closure 1hr before start of settlement period

Submission of a baseline is required:

- To allow fair and transparent performance monitoring
- To manage & facilitate state of energy for energy limited providers

Please see the next slide for more information on herding behaviour.



## 5. Baselines and ramp rate (2/2)

We need to avoid herding behaviour from energy-limited assets as they manage their State of Energy (SoE).

Ultimately, there will be ~1GW of DC and similar volumes of moderation and regulation, a large proportion of which can be provided by assets requiring SoE management.

A large frequency deviation will create a SoE need. For a provider to maintain availability, this will have to be met at the next opportunity (i.e. the next accessible pre-gate closure settlement period). Herding behaviour here creates a sudden and rapid increase in demand as assets submit charging PNs. This spike in demand creates the exact situation that the service is trying to alleviate: a need for fast acting frequency response.

The requirement on providers to submit a baseline makes the risk visible to ESO operational teams.

The baseline ramp-rate limit is able to mitigate the risk:

- For energy limited providers, a baseline may have a maximum ramp rate of (e.g.) 5% of service quantity.

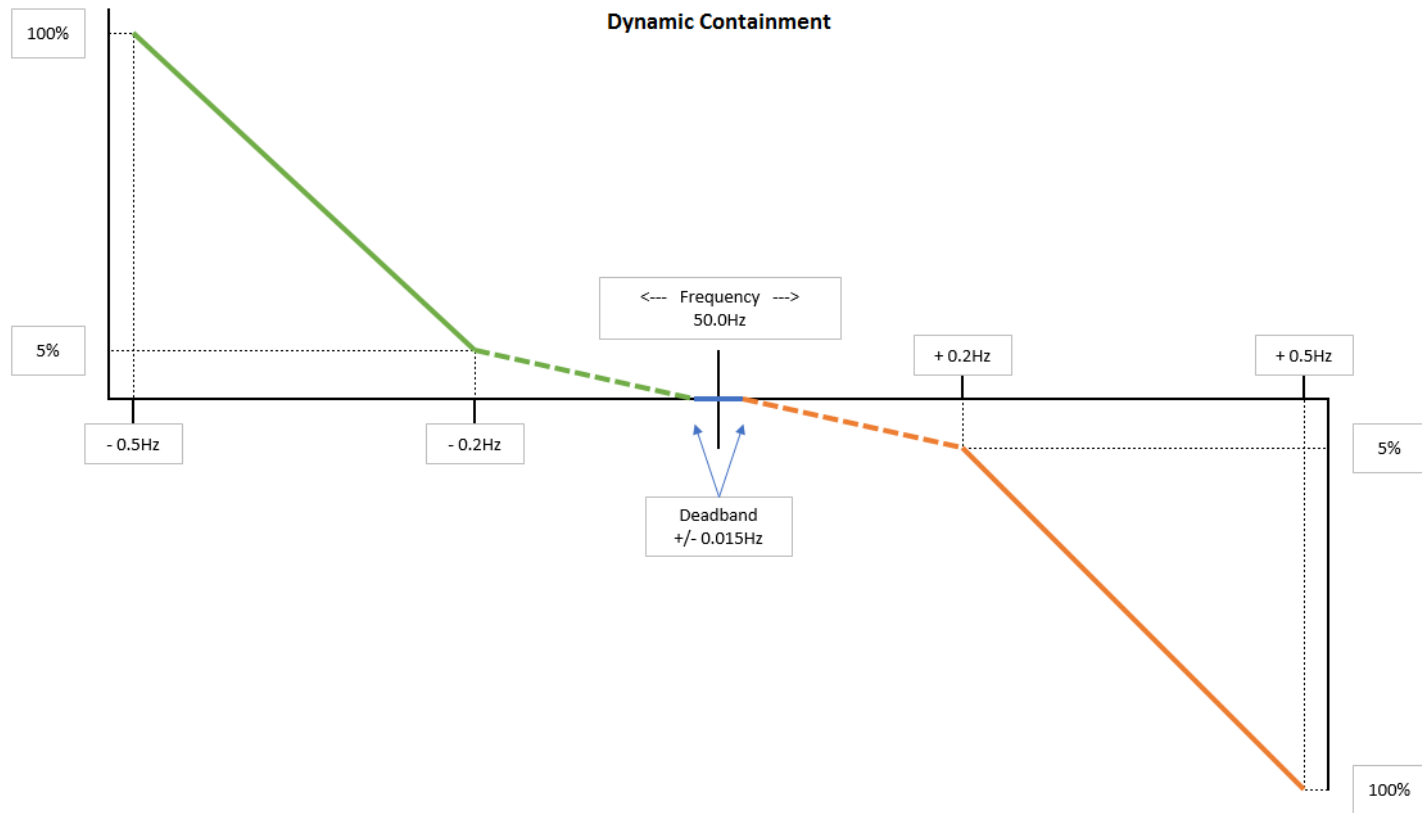


## 6. DC service specification (1/2)

- All frequency coordinates measured from the target frequency, 50Hz
- All delivery volumes measured against the contracted volume (e.g. x %)
  
- Deadband delivery is 0% (+/- 0.015Hz)
- Small linear delivery is required between 0.015Hz and 0.2Hz, to a maximum of 5% at 0.2Hz
- Knee point activation at +/- 0.2Hz is 5%
- Full delivery +/- 0.5Hz is 100%
- Linear delivery knee point (0.2Hz) and full activation (0.5Hz)
  
- Full delivery required in at most 1s but no faster than 0.5s



## 6. DC service specification (2/2)





## 7. Location and locational requirements

GSP group approximately maps the geographical area covered by the DNO license areas. This level of locational granularity is not enough to ensure secure network planning and operation.

A provider in GSP group 'x' can be anywhere between Land's End and Bristol.

### Locational requirements

- Each participating unit must be identified by its GSP
- Assets can be aggregated within a single GSP
- Each asset must measure frequency locally at their connecting point

Network constraints can sterilise volumes of response, only knowing the detailed locational information will allow the ESO to adequately plan for security.





## 8. Performance monitoring (1/2)

Performance monitoring processes and rules are required to be reinforced to ensure the system requirement is continuously met and NGENSO has better visibility of performance from service providers.

### Principles

- A fault could happen at any time, so the service always has to be ready
- To value it, we need confidence in the ability of providers to fulfil the service
- An expectation of 100% performance at all times is unrealistic and unreasonable
- A mechanism to incentivise good performance is needed, allowing some deviation from 100%
- Significant underperformance can only be tolerated for very short durations
- Very slight underperformance can be tolerated for longer durations

Performance will be measured as deviation outside a 'performance band'



## 8. Performance monitoring (2/2)

Providers will be required to respect the 'spirit of operation' and failure to do so may lead to a temporary ban from participation.

- a. This provision is required to discourage deliberately inaccurate baselines or other behaviour that can undermine the performance and effectiveness of the service.
- b. The contract will define the 'desired behaviours' and allow maximum flexibility to NGENSO to exclude participation for reasons of market manipulation or system security.



## 9. State of Energy (1/2)

We expect energy-limited providers to be a significant market participant for all our future frequency response products.

Our principles for addressing the challenge of state of energy management for providers of frequency response services are:

- NGENSO will provide clear guidance on asset sizing and appropriate contract volumes
  - e.g. to offer xMW of service a minimum asset size of yMW & zMWh is required
- NGENSO will provide clear rules on how a provider should maintain acceptable SoE
  - Including how to behave in instances of failure and RTS
- If the guidance and rules are followed then the provider should not experience SoE issues, if they do then it will be because NGENSO has not managed frequency appropriately
- Unavailability for commercial reasons will not be permitted, only for technical reasons (e.g. plant failure)
- Providers must maintain service provision throughout the contracted period(s) - provision and SoE management must occur simultaneously



## 9. State of Energy (2/2)

For energy limited providers:

Asset and contracted volumes should be sized appropriately considering NGENSO guidance.

The provider should manage the asset such that:

- Enough headroom and/or footroom is always available to deliver the full contracted volume.
- The SoE is always maintained within a target range as specified by NGENSO, e.g. 40% - 60%.
- At the end of each settlement period (SP), the SoE level is compared to the target range and a new baseline submitted for the next available SP to charge/discharge to return the SoE level back within the target range.
  - E.g. If the net energy delivered as a result of frequency response in SP24 is 10MWh (discharge) then a new baseline is submitted for SP28 to increase the stored energy by 10MWh.



## 10. State of Energy and clock error

Clock error can be thought of as a measure of the average frequency over a period of time.

Our new response products and their provision by energy limited providers will mean that NGENSO has to carefully manage clock error.

- Extended periods of high or low frequency can cause SoE challenges

Managing clock error means not allowing frequency to stay above or below 50Hz for too long and managing the average frequency close to 50Hz over a range of time periods; 15mins, 30mins, 1hr, 4hrs, 24hrs etc.

Dynamic containment has very small delivery in the operational range ( $\pm 0.2\text{Hz}$ ) and therefore there is no immediate need for clock error management.



# 11. Data requirements

Each unit needs to submit:

- Location data including postcode, latitude and longitude, the nearest DNO substation name it's connected to, and an indication of the nearest GSP for each asset;
- Other unit data (standard information that's required for the other energy products) e.g. owner, name plate, MWs, fuel type, commissioning date, manufactory data etc.;
- Baseline data submission against which their service delivery is measured;
- State of energy information in their baseline and real time data for energy limited providers;
- Metering data
- Performance monitoring data



## 12. Settlement

Providers are paid for availability only, minus unavailability and a service performance measure (SPM) calculated based on delivery compared to a tolerance band.

Other elements that may be included in the SPM:

- Accuracy and reliability of data provision
- Performance against baseline and ramp-rate rules

### Unavailability

Unavailability is permitted only for technical reasons, **NOT** permitted for commercial reasons.

We will require the failure mode to be specified, so:

- we can monitor the incidence of failure modes and review our resilience to common failure modes, and,
- request evidence that the unavailability facility is not being gamed.

Timely notification of unavailability will be required.



## 13. DC: engagement on product design



\*following feedback, we have extended the feedback timescale to four weeks



## 14. Over to you...



Complete the feedback survey (link below) to provide your thoughts on our proposal of Dynamic Containment.

**DC feedback survey**



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