Firm Frequency Response (FFR)

Interactive Guidance

V1.0 December 2017

For information, please contact: commercial.operation@nationalgrid.com

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Version control

Version	Date published	Page No.	Comments
1.0	19/12/2017		

How to use this guide

- This document provides current and potential Firm Frequency Response (FFR) providers with clear, simple and transparent guidance on the service. It pulls together FAQs on the service and provides links to related documents, such as testing guidance and Market Information Reports.
- A menu button on each page allows access back to the main menu, or section menu where required:

- A toolbar runs along the bottom of every page, allowing for quick navigation to section menus. Coloured icons allow navigation to relevant sections of the document.

- Sections of the guidance are colour coded, for ease of use.

- Please contact commercial.operation@nationalgrid.com if you have any questions or feedback.

Note: icons on this page are for illustration only - links do not work.

Main menu

Select icons to navigate to relevant sections of this document:

1. FFR overview
2. Technical requirements
3. How to participate
4. Assessment principles
5. Stacked volumes
6. Market information

Coming soon!

YouTube FFR guidance videos

Key documents

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1. FFR overview

1.1. Context setting – system frequency and response

1.2. FFR service

1.3. Frequency response speeds

1.4. New providers – process to tender

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1.1. Context setting – system frequency and response

System Operator obligation	■ National Grid has a statutory obligation to maintain the frequency of the National Electricity Transmission System within ±1% of 50Hz (49.5 to 50.5Hz). ■ The control room normally control frequency within a tighter operational limit of 49.8 to 50.2Hz.
System frequency	■ System frequency is continuously changing – it is determined and controlled by the balance between demand and generation. ■ If demand is greater than generation, frequency falls. If generation is greater than demand, frequency rises. ■ National Grid must therefore ensure that sufficient generation and / or demand is held in readiness to respond to frequency variations.
Response	■ Response represents the ability to modify generation or demand to compensate for changes in system frequency within 2-30 seconds, depending on FFR service type.

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1.2. FFR service

FFR product types	■ The FFR service is split into two physical products, Non-Dynamic (static) and Dynamic frequency response. There are three main Dynamic service types - primary, secondary and high.
Response types	■ Non-Dynamic frequency response is triggered at a defined frequency deviation which is specified in the providers Framework Agreement, which must be in place before tendering. No response is required within the operating range. ■ Dynamic frequency response is continuously provided and is used to manage second-by-second frequency variations. Dynamic response is automatically delivered for all frequency variations outside of the deadband (50Hz ±0.015Hz).
BM and Non-BM providers	■ The FFR service is open to both BM and Non-BM providers. Providers can offer other balancing services when they are not providing FFR. ■ Aggregated loads, when summated, must be equal to or greater than 1MW. ■ There must be a single point of dispatch or a method in which the total output of the combined loads can be monitored to demonstrate to National Grid that the service is available.

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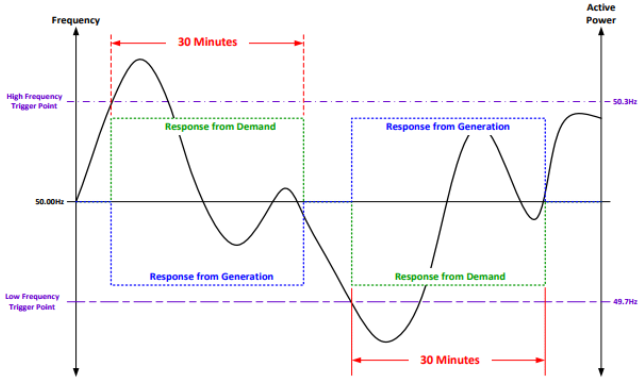
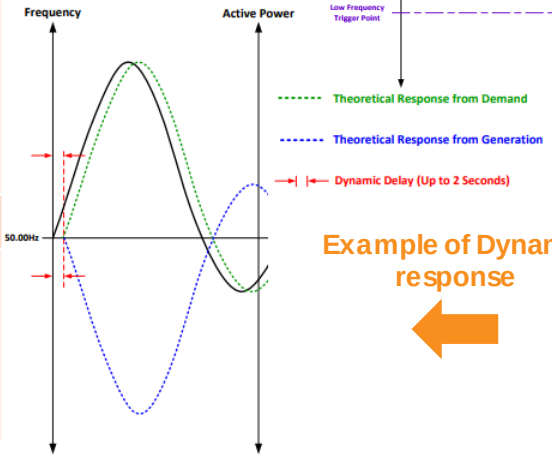
1.3 Frequency response speeds

FFR product type		Response speed	Length of response
Non-Dynamic – Secondary response is the only Non-Dynamic response currently procured.		Within 30 secs	30 mins
Dynamic – A Dynamic service can provide Primary, Secondary and High response, or Primary and Secondary only or High only.	**Primary**	Response required within 2 secs, with full response by 10 secs.	20 secs
	Secondary	Within 30 secs	30 mins
	High	Within 10 secs	Indefinitely unless otherwise agreed.

Example of Non-Dynamic response





Example of Dynamic response

1.4. New providers – process to tender

Stage 1: Conduct initial research prior to contact with National Grid

- Read through this guidance document and relevant information to understand the requirements for providing an FFR service. Understand whether Dynamic or Non-Dynamic response best suit your asset(s).

Stage 2: Initial contact with National Grid

- Contact Commercial.Operation@nationalgrid.com with your initial enquiry. You will be assigned an Account Manager. Arrange an introductory telephone call or face to face meeting and progress to service provision with Account Manager support.

Stage 3: Sign Framework Agreement

- An FFR Framework Agreement must be signed before participating in the monthly FFR tenders. Links to Framework Agreements can be found on the Key Documents slide of this document.

Continued...

1.4. New providers – process to tender

Stage 4: submit FFR tender(s)

- Once a Framework Agreement is in place, the provider will be given access to the online portal, ARIBA, where tenders can be submitted each month.
- FFR monthly tenders alternate between procuring for the short term requirement (month ahead only) and for both the short and long term requirement (from month ahead to 30 months out).
- The maximum contract award is 24 months.
- The tender must start within 6 months of the first available tender date. E.g. tenders awarded in January must start within 6 months from 1 February.
- Most FFR tenders are made up of an availability fee (£/hr), which is a price per hour of availability. Some providers also state a nomination fee (£/hr).This payment is made for each hour that is nominated for delivery.

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2. Technical requirements

- Prospective FFR Providers must meet the following technical requirements in order to tender in for FFR:

Minimum size	■ Minimum response is 1MW. This can be from a single unit or aggregated from several smaller units.
Frequency sensitive mode	■ Providers must have the capability to operate (when instructed) in a frequency sensitive mode for Dynamic response, or change their MW level via automatic relay for Non-Dynamic response.
Dispatch	■ There must be a single point of dispatch or a method in which the total output of the combined loads can be monitored to demonstrate to National Grid that the service is available.

- **Communication with National Grid** – there is no need to install systems in order to communicate with National Grid for performance monitoring purposes. However, second by second FFR data must be provided via e-mail to your Account Manager on request.

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3. How to participate

3.1. Sign Framework Agreement

3.2. Successfully test FFR Unit(s)

3.3. Tender to provide services

3.4. Information for providers with new build FFR assets

3.5. Performance Monitoring trial

3.6. State of Charge management

Coming soon!

3.1. Sign Framework Agreement

FFR Framework Agreement:

- Gives contractual effect to the relevant provisions of the Standard Contract Terms (SCTs) between National Grid and the FFR Provider.
- Contains service data specific to the providers FFR Unit(s) which the provider wishes to submit an FFR tender(s) for.
- Must be signed by the FFR Provider and National Grid before tenders can be made.

There are different types of FFR Framework Agreement for different types of service provider:

- Balancing Mechanism participants delivering Dynamic response from BM Unit(s).
- Non-Balancing Mechanism participants delivering Dynamic or Non-Dynamic FFR from Non-BM Unit(s) via single or aggregated loads.

Substitution of FFR Units is acceptable, if the Units are specified in the Framework Agreement. The performance of the substituting unit needs to be at least equal to or better than the original contracted unit.

Links to each of the template FFR Framework Agreements can be found on the following page of this document:

Key documents

3.2. Successfully test FFR Unit(s)

FFR Providers must successfully complete unit testing before delivery. The purpose of testing is to verify that the requirements of the service as specified in the Framework Agreement can be met. Click the links below for more information about each of the tests:

Non-Dynamic test

Dynamic test (1) – Step test

Dynamic test (2) – Frequency sweep tests

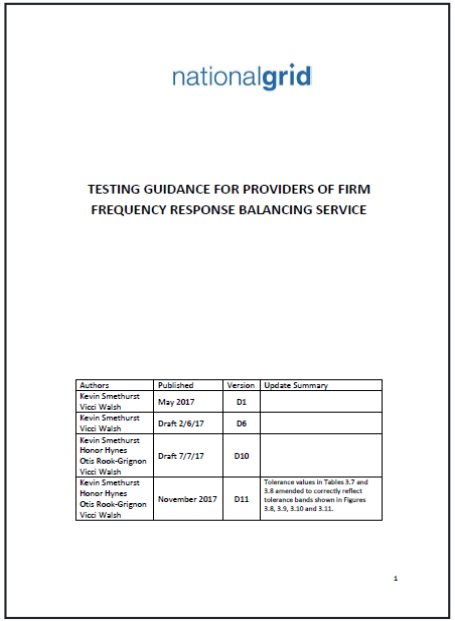
Dynamic test (3) – Duration tests

Dynamic test (4) – Connection to Grid test

High Frequency Response will be tested for a duration of 30 minutes but the service should be capable of being sustained indefinitely, unless agreed otherwise.

Currently, Secondary response is the only Non-Dynamic response procured. A Dynamic service can provide Primary, Secondary and High response, or Primary and Secondary only or High only.

Testing guidance document for FFR Providers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TESTING GUIDANCE FOR PROVIDERS OF FIRM FREQUENCY RESPONSE BALANCING SERVICE

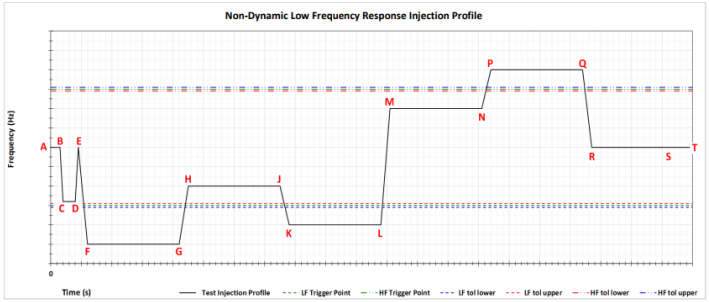
Authors	Published	Version	Update Summary
Kevin Smethurst Vicci Walsh	May 2017	D1	
Kevin Smethurst Vicci Walsh	Draft 2/6/17	D6	
Kevin Smethurst Honor Hynes Otis Rook-Grignon Vicci Walsh	Draft 7/7/17	D10	
Kevin Smethurst Honor Hynes Otis Rook-Grignon Vicci Walsh	November 2017	D11	Tolerance values in Tables 3.7 and 3.8 amended to correctly reflect tolerance bands shown in Figures 3.8, 3.9, 3.10 and 3.11.

Non-Dynamic test

The Non-Dynamic low and high frequency tests aim to monitor the ability to deliver the minimum contracted level of response.

Pass criteria for test:

- The correct frequency injection profile is used.
- The response occurs at the correct contracted trigger frequency and within the permitted tolerance (±0.01Hz).
- The response must be sustained for 30 minutes.
- The standard deviation of response error over a 30 minute period must not exceed 2.5% of the contracted response.
- The injected frequency signals are 49.7Hz / 50.3Hz. The length of both tests is approximately 2100 seconds in the case where the providers are providing a 1800 second response.
- If the agreed response time is longer or shorter than 1800 seconds, the test may be proportionately increased or decreased.



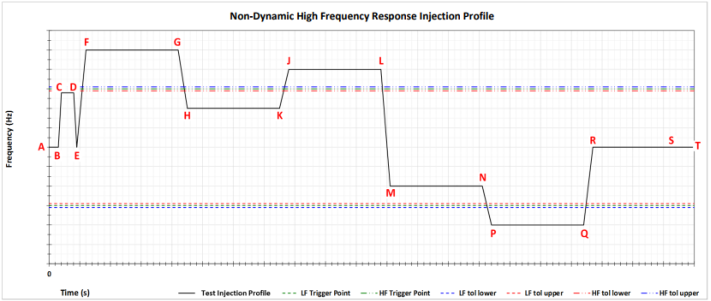


Figure 2.2 - Injection Profile for High Frequency Non-Dynamic Response Testing

Dynamic test (1) – Step test

This test is designed to ensure the system responds when the frequency moves outside of the +/- 0.015Hz dead band.

Pass criteria for test

- Delay in response is no greater than 2 seconds.
- Minimum response must be within the allowable tolerances for Primary, Secondary and High frequency timescales.
- The standard deviation of load error at steady state over a 180 second period must not exceed 2.5% of the maximum contracted response. Response should progressively change to its contracted output.
- Each step is sustained for 180 seconds. The frequency will then be returned to 50Hz for a minimum of 30 seconds, or until the output is stable, before the next injection is applied.

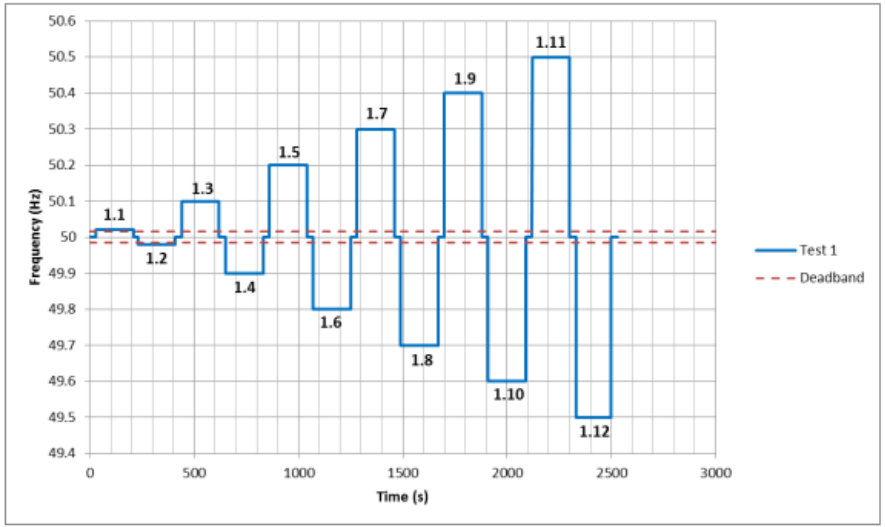


Figure 3.1 – Test 1 Injection Profile

Dynamic test (2) – Frequency sweep tests

These tests comprise of frequency ramps from 50.6Hz to 49.4Hz and then from 49.4Hz to 50.6Hz, in order to examine the entire performance envelope. The test will verify the providers ability to provide the correct response in accordance with the injected frequency and will observe the active power as the frequency passes through the deadband. See the page 11 of the guidance document for more information.

Pass criteria for test

- Delay in response must be no greater than 2 seconds.
- Response must be consistent with the contracted values within the allowed tolerances, as shown in the guidance document.

- For the first two frequency sweep tests, the ramps will be injected over 30 seconds.
- For the second two frequency sweep tests, the ramps will be injected over 90 seconds.

Dynamic test (3) – Duration tests

This test requires the service provider to be able to respond at full output for 30 minutes. This is carried out by a frequency step of ±0.6Hz onto the system for 30 minutes.

Pass criteria for test

- The standard deviation of load error at steady state over an 1800 second period must not exceed 2.5% of the maximum contracted response.
- Response must be sustained for 30 minutes.

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Dynamic test (4) – Connection to Grid test

This test investigates the ability to respond to live system frequency. The response against the system frequency will be recorded for 1 hour.

Pass criteria for test

- Provide a response consistent with the contracted performance within Primary, Secondary and / or High frequency response timescales.

NOTE: for all tests, data needs to be submitted in a format compatible with Microsoft Excel. The data should be clear and concise with no ambiguities. Each test will need to be recorded on an individual worksheet and include:

- Identification of the asset
- The location
- Company name
- Date of the test
- Associated test number
- Service being provided (High Frequency Non-Dynamic, Low Frequency Dynamic, etc.)

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3.3. Tender to provide services

- FFR is tendered via a competitive tender process which runs once a month.

Business Day 1: Market Day

FFR tenders must be submitted no later than 17.00 in the E-Tender system ARIBA.

Business Day 12: Tender Results Day

An FFR Tender Acceptance letter is issued to successful parties.

National Grid publish a Market Report summarising all FFR tenders received. The Market Report includes a summary of previously accepted tenders to give an overview of the current FFR market.

Market Reports can be found at the below link:

Market Reports

Business Day 18: Market Information Report published

The Market Information Report sets out the FFR requirements for the up-coming tender round and provides a summary of contracted volumes and information from the previous tender round.

Market Information Reports

3.4. Information for providers with new build FFR assets

- It is possible to tender in for FFR services if assets are not yet operational. The tender start date must be within 6 months of the tender submission and the maximum tender award is 24 months.

Mandatory Works Provisions

The Framework Agreement will contain Mandatory Works Provisions, which detail the work required and the timescales for completion.

FFR tender acceptance will be conditional upon the Unit successfully completing the Mandatory Works Provisions no later than the start date of the FFR tender.

If either National Grid or the FFR Provider have reason to believe that the Mandatory Works Provisions will not be satisfied, then the FFR Provider must submit a Cure Plan to National Grid.

Cure Plan

- Must set out how any delays in the Mandatory Works Provisions will be remedied.
- Must specify a reasonable extension to the target completion date, ie, when services will be provided.
- Will be approved or rejected by National Grid within 20 working days.

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3.5. Performance Monitoring trial

Aims and Objectives: To improve the accuracy of performance monitoring of Non-BM Dynamic FFR Providers to ensure that all providers are assessed on their actual performance against their FFR contract.

Current methodology for performance monitoring:

- Currently, performance is measured by the difference between demand / generation at the start of a sample period and its actual demand / generation.
- This does not capture true response from demand / generation with a naturally variable baseline.

Methodology proposed under the trial:

- Forecast based approach, where forecasts are generated and stored by providers close to real time.
- The difference between forecasted and actual delivery gives the true response.

Useful links:

Testing guidance for DSR providers

Notification of Optional Trial: Methodology for Performance Monitoring of Dynamic Firm Frequency Response

Final Proposal for Trial: Methodology for Performance Monitoring of Dynamic Firm Frequency Response

How to get involved: The trial is for an initial 9 month period with the opportunity to extend.
Providers are able to sign up to this trial at any time before 1st August 2018. Please contact your Account Manager for more information.

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4. Assessment Principles

- This section of the document aims to improve transparency about the FFR tender assessment process and provides a worked example for clarity.
- At a high level, National Grid assesses whether the cost of a submitted tender is likely to be more or less than the cost of alternatives to deliver the equivalent level of frequency response, and if the tender helps to fulfill the remaining requirement for each type of response. National Grid has a finite FFR requirement, which can be met by a combination of Non-Dynamic and Dynamic response.

4.1. Ensuring FFR tender compliance

From January 2018, non compliant tenders will be rejected prior to assessment. This section explains how to ensure that tenders are compliant with tender parameters.

4.2. FFR assessment process

National Grid has committed to increasing the transparency of the FFR tender process. This section outlines our assessment process and key principles.

4.3. Worked example – FFR assessment

This section gives a worked example of an FFR tender assessment, for clarity.

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4.1. Ensuring FFR tender compliance

- From January 2018, non compliant tenders will be rejected prior to assessment. This slide provides a checklist, which FFR Providers should use to ensure that tenders are compliant:

	Tender compliance checklist
✓	**The correct template in ARIBA has been used.** From Jan 2018, only tender returns on the latest version of the tender spreadsheet as issued via ARIBA will be assessed.
✓	**All mandatory fields in the tender spreadsheet have been completed.**
✓	**Check tender round timescales**. FFR tenders alternate on a monthly basis between procuring for the short term requirement (month ahead only) and for both the short and long term requirement (from month ahead to 30 months out). All tenders must be compliant with tender round timescales, so please check the dates.
✓	**Consult your Account Manager** for support / advice on the format of tender submission before the deadline.
✓	**Double check for clerical errors** for example on volume, price, parameters of tender. Ensure that all tenders are allowed under the Framework Agreement – i.e. units have been tested and volume does not exceed that as stated in Framework Agreement document.

4.2. FFR assessment process

- **Step 1: Ensure tender compliance** → **4.1. Ensuring FFR tender compliance**

- **Step 2: Comparison of the cost of FFR tenders received to the cost of alternative action in the mandatory market**

The assessment team consider how much each tender would cost to procure in the Balancing Mechanism (BM), allowing for cost differences in the BM for day and night periods. This cost is then compared against the tendered cost. Each tender is stacked in descending order of its cost benefit.

A tender has to be beneficial against what National Grid forecasts it can buy the tendered offer for in the Mandatory Frequency Response (MFR) market to be considered any further.

The MFR costs are built up of:

- Fulfilling reserve requirements
- Meeting response capability
- Energy balancing

Continued...

4.2. FFR assessment process

- **Step 3: Comparison against requirements and hedging strategy**

Requirements for FFR are outlined in the Market Information Reports (MIR) each month. All tenders are compared against the requirements stated in the MIR. Tenders which meet requirements, result in no over holding and are within NG's hedging strategy are considered for acceptance.

Tenders which meet requirements but also result in over holding are re-valued against any over holding they create. The periods of over holding in any tender are valued at zero benefit. Tenders are re-stacked in descending order of corrected benefit and are then assessed according to the hedging strategy.

Avoiding key periods

During the MFR comparison described in Step 2, some periods are of greater value than other periods throughout the day. Therefore, tenders that avoid key periods, such as TRIADs, are assigned a lower benefit compared to those which tender over these periods.

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4.3. Worked example – FFR assessment

- The below table shows an example stack of FFR tenders submitted for assessment:

Tender ref	Provider	Unit	Start date	End date	Duration (months)	P (MW)	S (MW)	H (MW)	Benefit
XX.101	1	1.01	01/10/17	31/10/17	1	40	50	40	150%
XX.201	2	2.01	01/10/17	31/03/18	6	25	40	0	100%
XX.301	3	3.01	01/10/17	31/03/18	6	25	25	25	75%
XX.401	4	4.01	01/01/18	30/04/18	4	10	15	0	50%
XX.501	5	5.01	01/01/18	31/03/18	3	125	125	125	48%
XX.601	6	6.01	01/04/18	30/09/18	6	25	25	25	3%
XX.701	7	7.01	01/12/17	30/09/18	10	10	10	15	-35%

Continued...

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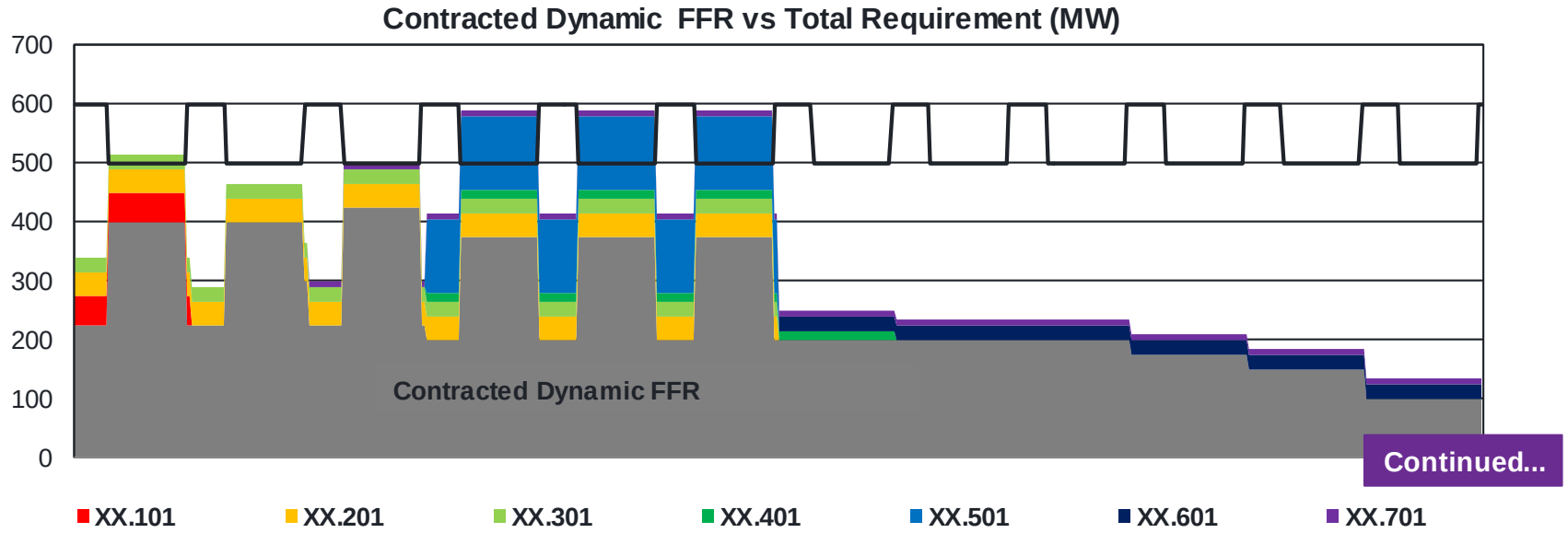
4.3. Worked example – FFR assessment

- During assessment, each part of each tender (P/S/H) is compared to the total requirement. Any areas above the black line represent over holding and these parts of the relevant tenders are given zero value.



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4.3. Worked example – FFR assessment

- The FFR assessment decisions are set out below:

XX.101 Accept - helps to meet short term requirement and results in no over holding.

XX.201 Accept - helps to meet medium term requirement and results in no over holding.

XX.301 Accept - helps to meet medium term requirement, provides net benefit when over holding costs taken into consideration.

XX.401 Accept - as XX.201 above.

XX.501 Reject - Reason code 1.

XX.601 Reject - Reason code 2.

XX.701 Reject – Reason code 2.

No.	FFR Reason Code
1	Beneficial but other tenders provided a higher benefit and were accepted first. This resulted in the requirement being satisfied.
2	The price submitted was too high and did not provide any contract benefit against alternative actions including the mandatory and optional market.
3	Does not meet tender prerequisites. Please refer to the Technical requirements and tender compliance check list.
4	Multiple tenders were received for the same unit. Only the most valuable tender of the group was considered.

5. Stacked volumes

- 5.1. Stacked volumes – Q&A
- 5.2. Stacked volume – compliant methodology
- 5.3. Stacked volume – non compliant methodology
- 5.4. FFR Review – Detailed Change Proposal

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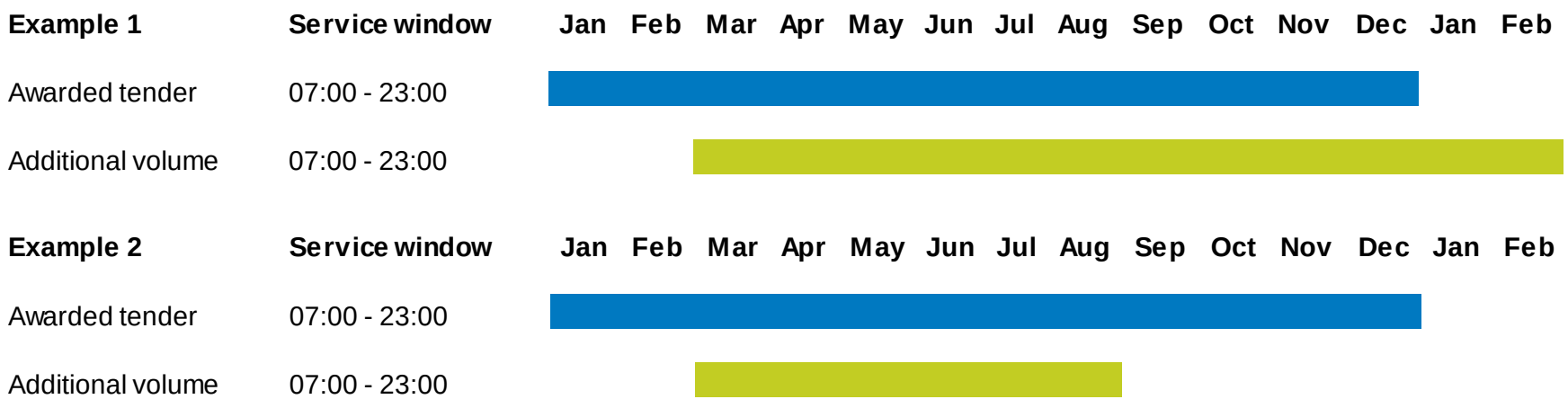
5.1. Stacked volumes Q&A

Question	Answer
How do I add volume?	■ To add volume, there must already be an existing FFR contract in place for the FFR Unit(s) that the provider wishes to add volume to. ■ The additional volume must be tendered as normal and will be assessed in isolation to any previously awarded contracts.
Does my stacked volume tender need to match the original contract length?	■ No, but the stacked volume needs to start within the contracted period of the contract that you are looking to add volume to. ■ The service windows must remain the same as the original contract.
Can I stack on top of an existing all or nothing awarded contract?	■ Yes. ■ The service windows must remain the same as the original contract.
How do I test additional volume?	■ Providers can either re-test the total stacked volume or just test the new volume being added to the stack. In either case, the testing would be in line with the current testing document published on the National Grid website and explained in Section 3.2 of this document.

5.2. Stacked volume – compliant methodology

- In the examples below, the methodology for adding additional volume to an existing contract is compliant.
- The stacked volume tender starts within the contracted period of the contract that the provider is looking to add volume to and the service windows remain the same as the original contract.
- The stacked volume tender does not need to match the original contract length.



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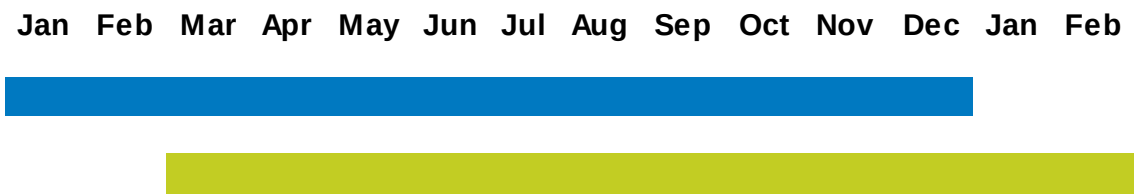
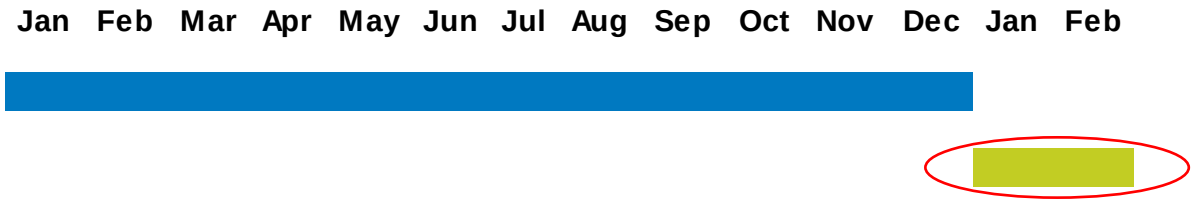
5.3. Stacked volume – non compliant methodology

- In both of the examples below, the methodology for adding additional volume to an existing contract is non compliant.
- In Example 3, the service window does not match the awarded contract.
- In Example 4, the additional volume tender does not commence during the contacted period of the awarded tender.

Example 3	**Service window**
Awarded tender	07:00 - 23:00
Additional volume	**07:00 - 07:00**



Example 4	**Service window**
Awarded tender	07:00 - 23:00
Additional volume	07:00 - 23:00



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6. Market information

In response to feedback, we have developed a new format for the monthly Market Information Report, which is available on Business Day 18 of every month.

Coming soon!

In the new template, key information is easier to locate. The Market Information Report will follow the same structure each month:

- Requirements for up-coming FFR tender round
- Summary of previous FFR tender round results
- Key messages
- Observed market trends
- Appendix 1: Daily FFR requirement (data table)
- Appendix 2: Contracted volumes (charts)

Market Information Reports available here

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Key documents

Useful links

FFR Standard Contract Terms (SCTs)

FFR Calendar 2017/18

FFR testing guidance

Flexibility workstream update: rationalisation of products and short term actions in the FFR market letter to industry

Firm Frequency Response Simplification update

Performance methodology trial

LIVE frequency data

FFR Framework Agreements