Statnett

Appendix 2:

Approval Process for Delivery of Automatic Frequency Restoration Reserves (aFRR)

Version June 2023

Document

This document must be reviewed accordingly if the scope is modified or other significant changes are made that impact the interpretation of the document, e.g. changes in the market conditions.

Version	Revision	Author	Date
0.1	Initial draft SN	DW	04-01-2011
1.0	Internal version	DW	19-10-2011
2.0	External version	DW	04-11-2011
3.0	External version	DW	09-01-2012
4.0	Updated version		01-10-2021
5.0	Revised version	LPA/FP	01-06-2023

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1 Definitions

aFRR	*Automatic Frequency Restoration Reserves (aFRR)* are automatically activated from the TSOs. The purpose of aFRR is to release primary reserves and bring the frequency in the power grid back to its nominal value of 50.00 Hz.
aFRR providing unit	An aFRR providing unit is a controllable object realised by **one single asset or a group of assets.**
Assets	Power producing/consuming/storing assets such as hydro generators, wind turbines, solar power installations, energy storage, consumption facilities and so on that deliver aFRR to Statnett will be referred to as *assets* in this document.
BSP	A Market Participant providing Balancing Services to its Connecting TSO, or in case of the TSO-BSP model, to its Contracting TSO.
BSP's Control System	The BSP's Control System, i.e. automatic generator control, is a control function running in the BSP's SCADA system. It needs to have automatic transmission of set points to the asset and must be able to take control orders sent by the TSO and execute them. The control system should not have any other closed loop frequency functions other than that of primary reserve. The TSO orders are combined with the BSPs' predefined generation schedule. It is assumed that the system has a control function for executing the schedules. The control system does not have to be a closed loop system, but it is preferable. It is used to transfer the control orders from the TSO to the assets. The details of how this is done are up to the BSP and its implementations. Some requirements are mandatory to ensure that the aFRR functions correctly.
Full Activation Time (FAT)	The period between the activation request by the connecting TSO in case of TSO-TSO model or by the contracting TSO in case of TSO-BSP model and the corresponding full delivery of the concerned product.

DSO	The DSO (Distribution system operator) is operating the local and/or the regional power distribution grid.
Asset/production mix	An aFRR providing unit can be made up of one or more assets. The TSO provides the set points which the BSP distributes as they see fit while staying mindful of the performance requirements. It could, for example, be possible to combine a large and slow production unit with a fast, smaller unit. This would provide the capability to provide aFRR from the slow unit without compromising with the performance requirements. To approve this set up, the mix of generators must be documented and used for subsequent deliveries. This is to ensure that the uniform product is delivered.
Station group	A Station group is a set of assets that are co-located and connected to the electrical power grid via several substations. If the TSO approves it, a Station Group can be treated as one aFRR providing unit. This approval will be part of the prequalification process.

2 Introduction

This document describes the qualification process for approval of a single asset or a group of assets to be eligible to deliver automatic Frequency Restoration Reserves (aFRR). The qualification process consists of three main processes that needs to be completed and approved before the BSP may participate in the market by submitting bids for the given asset. The asset must first complete a technical prequalification. Secondly, any connections needed in regard of communication and control between Statnett and the BSP need to be established and tested. Finally, the BSP need to integrate the asset in the market platform.

2.1 The qualification process

The following list describes the main steps in the qualification process to be performed by the BSP. The process is also depicted as a flowchart in Figure 1

1. The BSP completes part A and B of the application form found on statnett.no[1], providing general information about the asset(s) and preferred prequalified balancing capacity. The form is sent to BSP@statnett.no for initiating the prequalification process.
2. Statnett assesses the grid connection for the asset proposed by the BSP.
3. Statnett informs the relevant Distribution System Operator (DSO) of the application.
4. Statnett and the BSP agrees on a test profile that covers the preferred response.
5. The BSP performs a self-response test.
6. The BSP completes part C of the application form. The form must be sent to BSP@statnett.no together with all test results for a formal assessment of the application.
7. If the application fulfils the requirements, the qualification process continues from point 9 and onwards.
8. If the application is deficient, Statnett will provide feedback within 8 weeks. The BSP must then provide Statnett with the requested information within 4 weeks. If not, the application is regarded as withdrawn.
9. The BSP's connectivity between their and Statnett's SCADA servers is assessed by Statnett. Establishing new connections may be required.
10. A signal test between SCADA servers is performed in cooperation with Statnett.
11. The BSP must also connect to the Nordic aFRR capacity market platform, Fifty Nordic MMS[2,3].

[1] https://www.statnett.no/for-aktorer-i-kraftbransjen/systemansvaret/kraftmarkedet/reservemarkeder/sekundarreserver/

[2] Market handbook: https://nordicbalancingmodel.net/wp-content/uploads/2022/08/Nordic-Handbook-aFRR-Capacity-Market.pdf

[3] Implementation guide: https://www.statnett.no/globalassets/for-aktorer-i-kraftsystemet/systemansvaret/reservemarkeder/implementation-guide-afrr-capacity-market-bsp_v2.6.pdf

12. Statnett makes sure the BSP is registered in the relevant systems and informs the BSP when everything is ready for delivery of aFRR

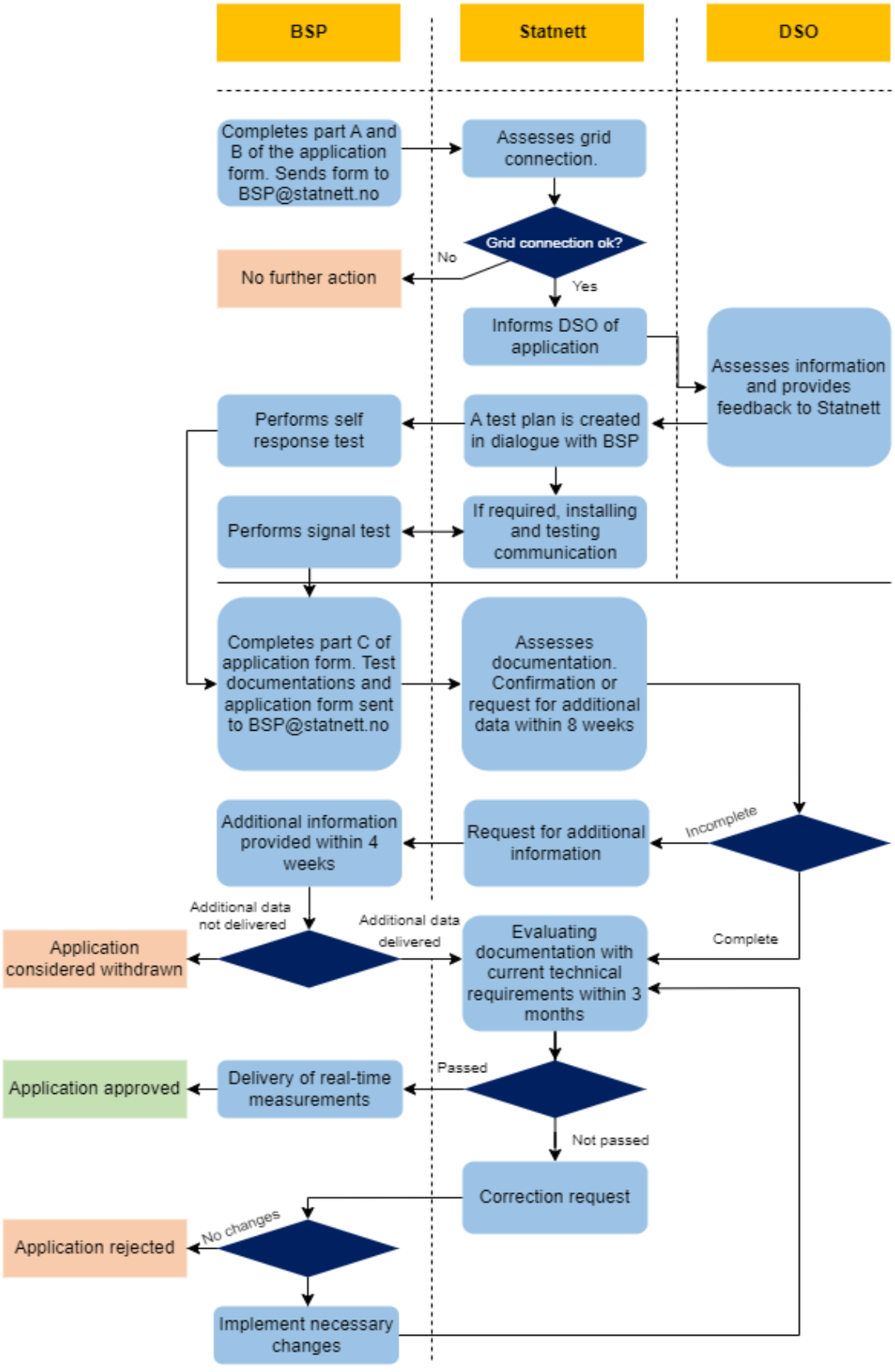

Figure 1: Flowchart of the aFRR qualification process.

3 Requirements

This chapter explains the requirements that must be fulfilled by the BSP during qualification and testing for delivery of aFRR.

The BSP may apply for an exemption from the technical requirements listed up in this approval document.

3.1 Grid connection

Before testing can commence, Statnett will assess the grid connection and geographical location of the asset proposed by the BSP. If the grid connection is not satisfactory, the BSP will receive a written declaration.

3.2 Connectivity requirements

The BSP must document that they fulfil the communication criteria defined *in Appendix 1: Technical Product and Interface Specification for Delivery of Automatic Frequency Restauration Reserves to Statnett* (from here on referred to as the technical document) before the signal test of the qualification process start. The technical document can be found on Statnett.no[4].

Failure to provide the required communication arrangements may result in disqualification of the asset.

3.3 Signals

The signal test requires operable communication with the BSP and all its aFRR providing units. The signals used for communication shall be implemented and properly managed by the BSP. The signals are transferred by ICCP, or another appropriate protocol defined by Statnett. See the technical document for more details on these signals. All signals used in the test shall be logged by both Statnett and the BSP.

3.4 Measurements

The BSP is required to provide high resolution measurements of all the asset's responses that partake in the prequalification test. A sampling rate of one measurement per second is preferred[5]. The resolution of the measurements shall be 0,01 MW or better for instantaneous active power with an accuracy of 0,01 MW and 0,01 Hz or better for grid frequency with an accuracy of 0,01 Hz.

The reporting measurement dead-band should be kept low during the test. No more than 0,5 MW.

[4] https://www.statnett.no/for-aktorer-i-kraftbransjen/systemansvaret/kraftmarkedet/reservemarkeder/sekundarreserver/

[5] Lower resolution may be approved but the sampling time can not be higher than the sampling time under normal operation (10 seconds)

3.5 Mix of Assets

The mix of assets used in qualification should be documented by the BSP.

The BSP can use a different mix of assets within the aFRR providing unit as long as the response is in line with the product specification in the technical interface specification and the mix of assets is successfully qualified. Several combinations of the assets can be requested for qualification. In any event, the BSP will be held responsible to deliver the required response once balancing capacity has been procured.

3.6 System tuning

Prior to BSP requesting qualification the control system must have been tested and tuned such that the aFRR providing unit meets the technical interface specification.

These internal tests, including the accuracy of meeting set point changes within 30 seconds of reaching the target set point, should be provided to Statnett together with the application form.

3.7 Frequency Containment Reserves (FCR)

If possible, the BSP shall disable FCR within the aFRR providing unit for the duration of the prequalification test.

4 Test procedure

The test procedure consists of a response test conducted by the BSP, and a signal test conducted by the BSP in cooperation with Statnett.

The BSP shall complete part A and B in the application form and send this to Statnett no later than a month prior to the requested prequalification time. Part C of the application form should be completed in dialogue with Statnett.

Technical requirements are defined in the technical document.

4.1 Self-response test

The self-response test will be conducted by the BSP and they will change the set-point themselves. The time slot for the test must, however, be agreed upon with Statnett, and the BSP should inform the National Control Center at least two days before conducting the self-response test.

Statnett may require observing the self-response test.

A predefined sequence of set points will be sent to the aFRR providing unit. The sequence will excite the maximum (ΔP Max) and minimum (ΔP Min) regulation of the desired prequalified balancing capacity for the aFRR providing unit. If the grid situation requires, the test may be conducted with a lower maximum excitation.

If the desired test regulating margin is symmetric, the test will be energy neutral in every hour, meaning that the test will regulate up and down, equally. The accepted respond to a change in set-point is shown in Figure 2.

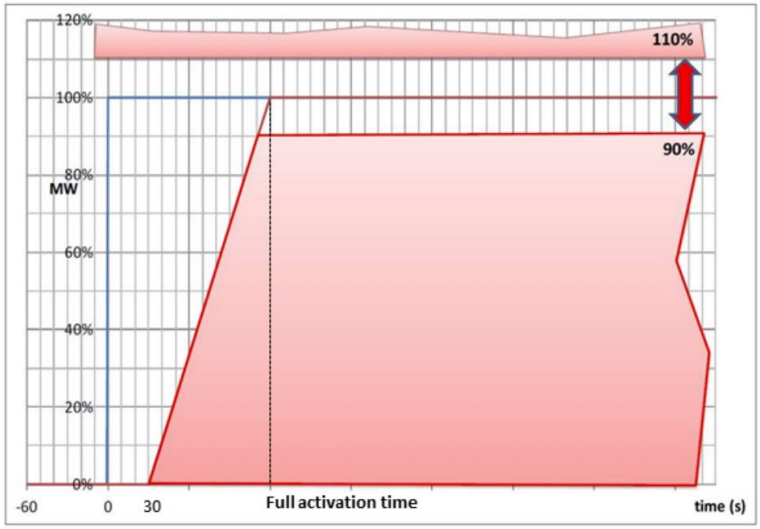

Figure 2: Accepted response to a change in set-point.

Figure 3 shows an example of a test sequence. Statnett will however specify the specific test sequence in dialogue with the BSP. Table 1 shows the example test sequence in table form.

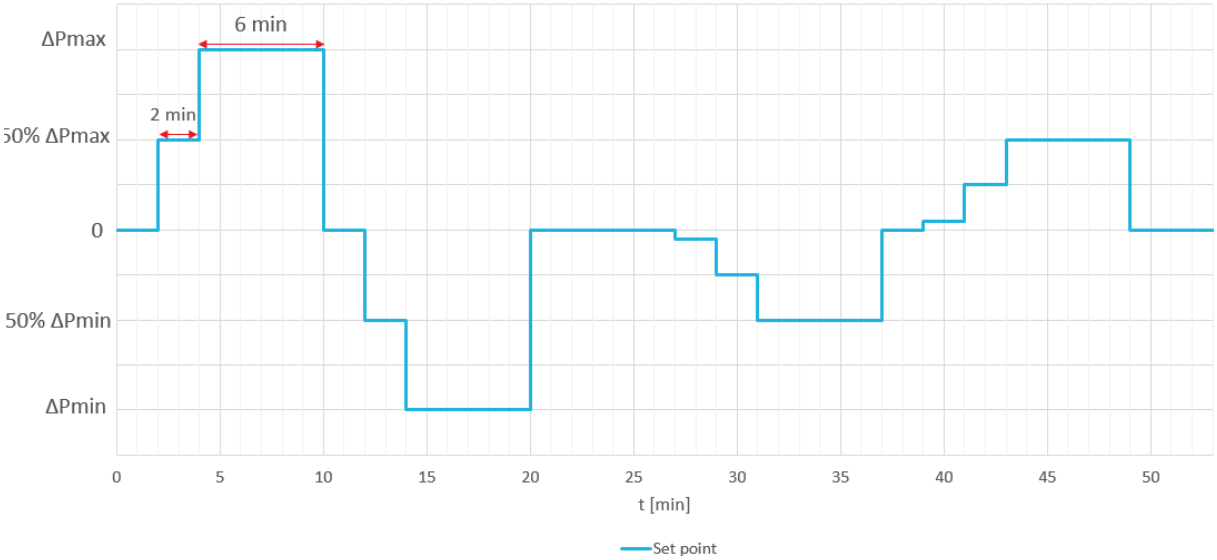

Figure 3: Example of a test sequence for the self-response test.

Table 1: Example of a test sequence in table form for the self-response test.

Time [min]	Set point [MW]
0	0
2	50% ΔPmax
4	ΔPmax
10	0
12	50% ΔPmin
14	ΔPmin
20	0
27	-1
29	-5
31	-10
37	0
39	1
41	5
43	10
49	0

In addition to testing the desired response, the self-response test will also examine whether the control system responds correctly to a simulated loss of communication over a short period of time.

4.1.1 Test data to be logged and format

Data logged during the response tests shall be provided to Statnett and should as a minimum include the below listed quantities. The data shall be provided in the format described under. A separate file for each test has to be prepared and named according to the scheme below

[Date]_[asset]_[Test].csv

Where:

- [Date] = The day the test is performed in format YYYYMMDD, e.g. 20190310
- [asset] = Identifier for the asset agreed with Statnett, e.g. <asset name>G1
- [Test] = the test performed “aFRR_response_test”

The file format for data delivery is the European standard csv-file, character encoding in ASCII where values are delimited by semicolon (;), decimal separator is comma (,) and record delimiter is carriage return (↲ ASCII/CRLF=0x0D 0x0A). Date and time formats are in accordance with ISO 8601 and are specified below.

The first line in the csv-file must be a header defining the parameter name. For the evaluation, the following parameters are required to be logged:

- [DateTime] – the day and time of the day the test is performed in format YYYYMMDDThhmmss, e.g. 20190310T121000.
- [GridFreq] – measured frequency in Hz.
- [RecSetP] – Received set point for active power [MW] from Statnett or BSP. The set point must be a delta in the positive/negative direction with the intention of changing the original production plan.
- [AgcActualMw] – calculated measurement value showing the actual aFRR contribution [MW] and should be as close to the received set point as possible according to FAT.
- [ContSetP] – controller set point for active power [MW] sent to the asset. Must be the desired power output level according to the received set point.
- [InsAcPow] – measured active power output level [MW] from the asset.

Example: Format which the data records should be provided:
DateTime;GridFreq;RecSetP;…
[DateTime];[record1];[record2];…;[recordX]
etc.

Statnett may require information about the droop setting and maximum active power of the asset in cases where FCR contribution cannot be turned off. Sample rate and resolutions are defined in Chapter 3.4.

The BSP may choose to add extra columns of measurement data if it can provide more information about the asset's response. In addition to the log file with raw data, the BSP can attach a screenshot etc. which visualizes the test progress.

4.2 Signal test

Before undergoing the signal test, the BSP should provide documentation that the control system can comply with the requirements. The documentation should include measurements of the response to a step in the aFRR providing unit's set-point and should show a response that is in accordance with the requirements in the technical document.

The signal test is a central part of the qualification process and is conducted once the communication equipment between the BSP and Statnett is set up. Part 1 of the test focuses on the verification of signals sent from Statnett to the BSP. Part 2 of the test verifies the response of the aFRR providing unit and signals sent from the BSP to Statnett. This test is performed with both parties being in contact through telecommunication.

Parts of the signal test may be skipped if the asset in question is to be included in a previously qualified aFRR providing unit. In this case, a self-response test could be sufficient.

4.2.1 Prior to signal test

4.2.1.1 Other documentation from BSPs

Documentation verifying the BSP's method of communication and the results from tuning must be given to Statnett no later than a week before the test.

4.2.1.2 Timing

Statnett can cancel the approval test within an hour notice should the operational situation require it.

Statnett can require that the test is executed outside of normal office hours.

4.2.2 Procedure for the signal test

The signal test aims to verify that all signals are correct and that they are transferred as expected. The test will be performed by manually updating the signals and then verifying with the other party that the correct value is set. This is done either by phone or other means. Table 2 shows an example of a signal test based on 1 MW steps.

All signals used in the test shall be logged by both Statnett and the BSP.

Table 2: An example of a signal test based on 1 MW steps.

Part 1: Signals from Statnett to the BSP		
aFRR set point	Change the set point 0 4 -4 0	Read back values for every change.
aFRR Enabled	Turn the signal on Turn the signal off	Read back indication for every change
Part 2 signals from BSP to Statnett		
Actual aFRR contribution Current aFRR Reserves UP Current aFRR Reserves DOWN	Change all three signals: 0 4 -4	Read back values for every change
Remote control permitted Actual aFRR contribution Current aFRR reserves Up Current aFRR reserves Down Unit in limitation Up Unit in limitation Down Dynamic limitation signal	Turn the signals ON Turn the signals OFF	Read back indications for every change.

4.3 Assessment

Technical description

The request for prequalification is filled out properly, and all technical parameters are in line with the requirements.

Requirement OK	Yes ( )	No ( )	Comment

Grid connection

The grid connection at the station is considered to be good enough to handle the desired regulation.

Requirement OK	Yes ( )	No ( )	Comment

DSO

If relevant, the DSO has been informed and included in the prequalification process.

Requirement OK	Yes ( )	No ( )	Comment

Control system testing

The BSP has shown sufficient documentation that the control system is tuned and tested so that it is ready for prequalification

Requirement OK	Yes ( )	No ( )	Comment

Connectivity

The BSP has shown sufficient documentation that the communication interface is in order.

Requirement OK	Yes ( )	No ( )	Comment

Accuracy

The accuracy of an aFRR providing unit is defined by how precisely it responds to a change of the set-point.

During the prequalification, Statnett reserves the right to approve an aFRR providing unit with a larger accuracy error should this operationally be preferable. In such a case, it may be required that the BSP works to meet the required accuracy within a reasonable time frame.

The accuracy in the test is in accordance with the technical document.

Requirement OK	Yes ( )	No ( )	Comment

Full Activation Time (FAT)

The time from the signal is sent from Statnett to the generation has reached its target value is the FAT.

The total delivery time in the test is in accordance with the technical document.

Requirement OK	Yes ( )	No ( )	Comment

Response delay

The response delay time is defined as the time it takes between the signal has been sent from Statnett to the asset has started to regulate.

The response delay time in the test is in accordance with the technical document.

Requirement OK	Yes ( )	No ( )	Comment

5 Approval

5.1 aFRR providing unit approval

An aFRR providing unit is approved once all technical requirements are met. These requirements are found in the technical document and other documents referred to in this document. The signal test shall also have been performed, when needed.

5.2 Validity

The prequalification is valid for a period of 5 years. After 5 years, a reassessment will decide whether requalification is required.

Should the BSP modify the control system, the communication interface or the already prequalified aFRR balancing capacity, requalification will be required. Statnett shall be informed a minimum of one month prior to changes of this nature. Statnett will then decide if the aFRR providing unit will be accepted for future delivery.