Statnett

Appendix 2:

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

Version October 2021

Abstract

This document describes the approval test for a station to be eligible to deliver automatic frequency restauration reserves (aFRR) to Statnett.

It is a reference document for potential aFRR suppliers, for the team implementing aFRR in Norway and for the other Nordic TSOs who together with Statnett are committed to implementing aFRR in the Nordic Synchronous system.

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

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Preface

Purpose

This document aims to specify the test requirements for the approval of a BSPs control system and power generating assets delivering aFRR to Statnett SF.

1. Introduction

This document describes the self-test procedure for gaining a station's approval for bidding in the automatic Frequency Restoration Reserves capacity market at Statnett.

Stations that are approved will have an identifier and will be qualified within a band of maximum positive regulation and minimum negative regulation in steps of 1 MW.

1.1 Definitions

Assets	Power producing assets such as hydro generators, wind turbines, solar power installations and so on that deliver aFRR to Statnett will be referred to as *assets* in this document.
Station	A station can be a single generator or set of assets that are co-located and connected to the transmission network via a substation.
Station Group	A station group is a set of stations that are co-located and connected to the Transmission network via several substations. If the TSO approves a station group, it can be treated as a station and thus an aFRR unit. This approval will be part of the pre-qualification process.
BSP	Balancing Service Provider is the market participant that provides the balancing services to its connecting 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 an automatic transmission of set-points to the asset and must be able to take the control orders from the TSO and execute them. The control system should not have any other frequency closed loop 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 this preferable. It is used to transfer the control orders from the TSO aFRR to the generators. The details of how this is done are up to the BSP and its implementation. Some requirements are mandatory to ensure that the aFRR functions correctly.

aFRR Unit	An aFRR unit is a controllable object which is realised in **one single station**. From the aFRR prospective it is a single unit that is controlled with a single set-point. How this set-point is distributed among the physical generating units within the station is solely decided by the BSP's control system (see **Feil! Fant ikke referansekilden.**~~Figure 1~~). The BSP bids for supply given per aFRR unit. It must comply with the product parameters described in the aFRR product definition, see Appendix 1 *Technical Product and Interface Specification for Delivery of Automatic Frequency Restauration Reserves to Statnett*. The set-point signal from the TSO will always be multiples of the MW block size. I.E. if the MW block size is 1 MW. Because of the filtering in the main controller the total power demand will change gradually. This in turn means that most changes sent to the aFRR Unit are one step only.
Station/ generation mix	An aFRR Unit can be made up of one or more generators. 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 secondary reserves from the slow unit without compromising with the performance requirements. To approve this set up, the mix of generators is must be documented and used for subsequent deliveries. This is to ensure that the uniform product is delivered.
Full Activation Time (FAT)	The time it takes from the signal is sent from Statnett to the generation has reached its target value is the FAT.

2. Requirements

2.1 Validation of delivery

Statnett is responsible for validating a delivery from an asset based on the criteria defined in chapter 6. Should a combined delivery from the station be proposed by the BSP, where several assets are delivering simultaneously, Statnett may require additional technical information to assist in its analysis.

2.2 Communication 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*) before the pre-qualification tests start.

Failure to provide the required communication arrangements could result in disqualification of the station.

2.3 Signals

The approval tests require operable communication with the BSP and all its aFRR 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.

Table 1 - Signals between BSP and Statnett

Direction	Signal name	Signal type	Unit	Short Name*
SN -> BSP	aFRR set-point	Set Point	MW	FRR_Set_Point
SN -> BSP	aFRR Enabled	Indication		FRR_enabled
BSP-> SN	Remote control permitted	Indication		AGC_RCP
BSP-> SN	Received set-point	Measurement	MW	AGC_recv_SP
BSP-> SN	Actual aFRR contribution	Measurement	MW	AGC_actual_MW
BSP-> SN	Current aFRR reserves Up	Measurement	MW	AGC_res_up
BSP-> SN	Current aFRR reserves Down	Measurement	MW	AGC_res_down

BSP-> SN	Unit in limitation Up	Indication		AGC_lim_up
BSP-> SN	Unit in limitation Down	Indication		AGC_lim_down
BSP-> SN	Regulation Failure Alarm	Indication		AGC_alarm_fail
BSP-> SN	PFK alarm	Indication		AGC_alarm_pfk
BSP -> SN	Generator Participation Flag	Indication(s)		Gen_FRR_ON

For more details on these signals see the document *Technical Product and Interface Specification for Delivery of Automatic Frequency Restauration Reserves to Statnett*.

Table 2 Other relevant signals, these are not distributed between the parties

Signal Name	Comment	Signal Type
Frequency		Measurand
BSP_MW	Sum of production of the participating BSP generators	Measurand
Int_Dev	Interchange deviation	Measurand
ACE	Area control error	Measurand
FACE	Filtered ACE	Measurand
IACE	Integrated ACE	Measurand

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

2.4 Measurements

The BSP is required to provide high resolution measurements of all the asset's responses that partake in the aFRR approval test. In addition, the local frequency measurement should be logged with the same resolution.

The measurement dead-band should be kept low during the test. No more than 0.5 MW.

2.5 Mix of Assets

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

The BSP can use a different mix of assets within the station as long as the response is in line with the product specification in appendix 1 (*Technical Product and Interface Specification for Delivery of Automatic Frequency Restauration Reserves to Statnett)* and the mix of assets is successfully approved. Several combinations of the same assets can be requested for approval. In any event, the BSP will be held responsible to deliver the required response once capacity has been purchased.

2.6 System tuning

Prior to BSP requesting pre-qualification the control system must have been tested and tuned such that the station meets the technical interface specification AIS.

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 in Annex A1.

2.7 Other requirements

The BSP shall disable Frequency Containment Reserves (FCR) in the station for the duration of the approval test.

The TSO will assess the grid connection for a station proposed by the BSP and reserves the right to exclude the station from delivery of aFRR, if the TSO considers that it to be necessary for operation. In this case, a written declaration with advice will be provided by Statnett.

3. Request for technical aFRR installation test

3.1 Request from BSPs

The BSP shall complete the form in Annex A (Request for technical approval) and send this to Statnett no later than a month prior to the requested pre-qualification time.

Statnett shall confirm within a week the exact time of the approval test.

3.2 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 approval test.

3.3 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. Test procedure

4.1 Signal test

This 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 verify with the other party that the correct value is set. This is done either by phone or other means. Note that the test below is based on 1MW 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	Turn the signals ON Turn the signals OFF	Read back indications for every change.

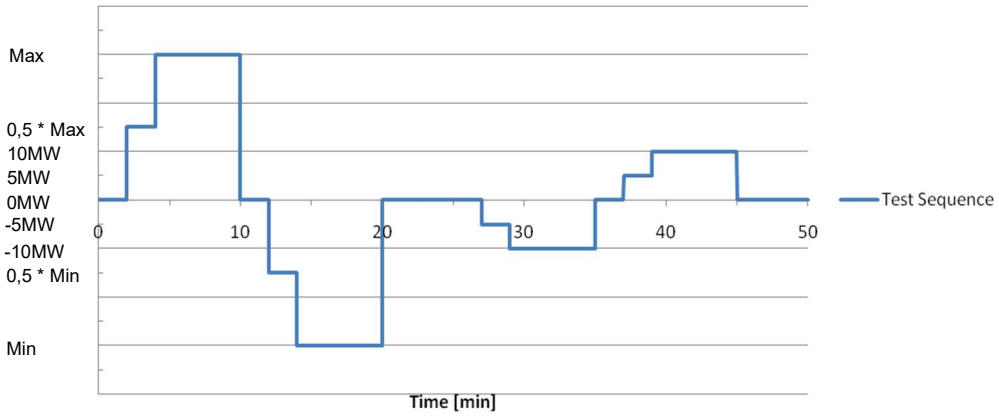
Current aFRR reserves Down Unit in limitation Up Unit in limitation Down Dynamic limitation signal Regulation Failure Alarm PFK alarm		

4.2 Self-response test

This test will be conducted by the BSP themselves in an agreed upon time slot. A predefined sequence of set points will be sent to the aFRR Unit. The sequence will excite the maximum (ΔP Max) and minimum (ΔP Min) regulation that the aFRR Unit wishes to be qualified for. If the grid situation requires it, 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 down as much as up.

The sequence will be as follows:



In table form:

Time [min]	Set-Point [MW]
0	0
2	50% ΔPmax
4	ΔPmax
10	0
12	50% ΔPmin
14	ΔPmin
20	0
27	-5
29	-10
35	0
37	5
39	10
45	0

In addition to testing the desired response, we will test that the control system responds correctly to a simulated loss of communication over a short period of time.

5. Assessment

5.1 Requirements

This section will include the assessment of the requirements described in chapter 3 and 4.

5.1..1 Technical description

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

Requirement OK	Yes ( )	No ( )	Comment

5.1..2 Grid connection

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

Requirement OK	Yes ()	No ( )	Comment

5.1..3 CONTROL SYSTEM Testing

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

Requirement OK	Yes ()	No ( )	Comment

5.1..4 Communication

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

Requirement OK	Yes ()	No ( )	Comment

5.2 Accuracy

The accuracy of an aFRR unit is defined by how precisely it responds to a change of the set-point. The change of generated power should be within 10% of the step size OR 1 MW of the change in Statnett set point, i.e. If the set-point changes from -10 to -15 the decrease in total generation should be between 4 and 6 MW. If the set-point changes from 20 to 35, the increase of the total generation on the assets should be between 13,5 and 16.5 MW.

In addition, the total sustained error should be no more than 5 MW, i.e. If the set-point is 80 MW the generation on the participating assets should be between 75 and 85 MW higher than their planned values (after adjusting for primary regulation).

A settling time of 120 seconds is allowed before the accuracy requirement should be fulfilled.

During the pre-qualification, Statnett reserves the right to approve an aFRR 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.

Requirement OK	Yes ()	No ( )	Comment

5.3 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 to the Appendix 1 (*Technical Product and Interface Specification for Delivery of Automatic Frequency Restauration Reserves to Statnett*).

Requirement OK	Yes ()	No ( )	Comment

5.4 Ramp Rate

The ramp rate required in the test is in accordance with the minimum requirements specified in the Appendix 1 (*Technical Product and Interface Specification for Delivery of Automatic Frequency Restauration Reserves (aFRR) to Statnett.*).

Requirement OK	Yes ()	No ( )	Comment

5.5 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 is in accordance to Appendix 1 (*Technical Product and Interface Specification for Delivery of Automatic Frequency Restauration Reserves to Statnett*).

Requirement OK	Yes ()	No ( )	Comment

6. Approval

6.1 aFRR Unit approval

An aFRR Unit is approved if it fulfils the requirements for delivery time, accuracy, and turn-time limit within the requested regulating volumes up and down.

6.2 Validity

The prequalification is valid for a period of 5 years after which time a new prequalification may be required.

Should the BSP modify the control system or the communication interface a new prequalification will be required.

Statnett should be informed a minimum of one month prior to changes of this nature. Statnett will then decide if the aFRR unit will be accepted for future delivery.

Annex A

A.1 Application for approval of an aFRR unit

This form should be filled out when applying for the prequalification test and sent to BSP@statnett.no.

<table>
<tr><td>Balance responsible:</td><td colspan="2">Station Group:</td><td colspan="2">Station:</td></tr>
<tr><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="5">Administrative contact person</td></tr>
<tr><td>Name:</td><td colspan="2">Mob:</td><td colspan="2">Email:</td></tr>
<tr><td colspan="5">Technical contact person</td></tr>
<tr><td>Name:</td><td colspan="2">Mob:</td><td colspan="2">Email:</td></tr>
<tr><td>Desired test date:</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Desired regulating volume:</td><td colspan="2">Up [MW] :</td><td colspan="2"></td></tr>
<tr><td colspan="2">Down [MW] :</td><td colspan="2"></td></tr>
<tr><td>Generators:</td><td colspan="4">List names of all generators that could be part of the aFRR Unit.
Specify in percentage which generators that are to be used in the test</td></tr>
<tr><td>Gen 1</td><td>% in test</td><td>Gen 2</td><td>% in test</td><td>Gen 3</td><td>% in test</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Gen 4</td><td>% in test</td><td>Gen 5</td><td>% in test</td><td>Gen 6</td><td>% in test</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Any reservations from the Prequalification document</td><td>Yes</td><td colspan="2"></td><td colspan="2" rowspan="2">If ‘Yes’, specify</td></tr>
<tr><td>No</td><td colspan="2"></td></tr>
<tr><td>Other comments:</td><td colspan="4"></td></tr>
</table>

A.2 Test documentation

Before undergoing the tests, 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 unit's set point and should show a response that is in accordance with the requirements in Appendix 1 (*Technical Product and Interface Specification for Delivery of Automatic Frequency Restauration Reserves (aFRR) to Statnett*).