

The English version of this Annex 1 of the Rules is for information purposes only. In case of discrepancies between English and Bulgarian version of this Annex 1, the Bulgarian version shall prevail.

ANNEX 1

**Minimum technical requirements to the modules/units
providing frequency containment reserve, automatic
frequency restoration reserve and manual frequency
restoration reserve**

CONTENTS

I. Technical requirements for frequency containment reserve (FCR) - conditions and parameters	3
1. General requirement	3
2. General and additional requirements for the provision of FCR	3
3. Technical information about the generating module	5
4. Procedure for the pre-qualification test	5
5. Pre-qualification test process	5
6. Control and payments for the participation in FCR	8
II. Technical requirements for automatic frequency restoration reserve (aFRR) - conditions and parameters	9
1. Technical characteristics defined by the standard product	9
2. General conditions for participation in aFRR	10
3. Parameters for participation in aFRR:	11
4. Technical requirements to the BSP for aFRR	12
5. Procedure for the pre-qualification test	13
6. Pre-qualification test process	14
III. Technical requirements for manual frequency restoration reserve (mFRR) – conditions and parameters	16
1. Technical characteristics defined by the standard product	16
2. General conditions for participation in mFRR	17
3. Parameters for participation in mFRR	18
4. Technical requirements to the BSP for mFRR	18
5. Procedure for the pre-qualification test	20
6. Pre-qualification test process	20
IV. Real-time information transfer requirements	22
1. General requirements for real-time information to FCR, aFRR and mFRR providers	22
2. Specific real-time information requirements to FCR providers	23
3. Specific real-time information requirements to aFRR providers	24
4. Specific requirements for real-time information to mFRR providers	25

I. Technical requirements for frequency containment reserve (FCR) - conditions and parameters

1. General requirement

1.1. Participation in FCR is admissible for generating modules of system importance, according to the BG Grid Code, Additional Provisions §43c, directly connected to ESO EAD transmission network.

1.2. The generating unit of the balancing service provider (BSP) shall have an energy resource sufficient to ensure the full FCR range, agreed with ESO EAD for at least one hour in both directions.

1.3. The BSP can participate in FCR, at the request of ESO EAD and after successfully passing the relevant pre-selection procedure, proving the technical capability of the generating unit to fulfill the requirements of the BG Grid Code and the SOGL (EU 2017/1485) and RfG (EU 2016/631) regulations.

1.4. The main technical requirements are given in Table 1.

Range of FCR	Acceptable insensitivity	Time for full activation of the FCR	Frequency deviation for full activation of the FCR	Droop/Statism	Dead band	Minimum Activation Period
MW	mHz	sec	mHz	%	mHz	min
±10 or ±15	±10	≤ 30	±200	Set by ESO	Set by ESO	Set by ESO

2. General and additional requirements for the provision of FCR

2.1. FCR (frequency dependent mode) is a frequency correction to a static characteristic of the active power set point of the generating module whose FCR is activated at the request of ESO EAD. The FCR function shall be integrated in the control system or turbine regulator of the generating module. The system frequency measurement shall be obtained from the voltage level of the bus bar (medium or high voltage) in the step-up substation of the generating module. A frequency signal error of not more than +/-10mHz for FCR shall be allowed.

2.2. The total FCR reserve shall be geographically distributed, as evenly as possible among the generating units capable of providing it, in accordance with BG Grid Code Art. 97.

2.3. The FCR is the positive part of the primary control range from the set point before the disturbance up to the maximum FCR output power.

2.4 The droop (statism) of FCR systems shall be an adjustable value, depending on the type and technical characteristics of the generating module. The value of the droop shall be set by ESO EAD according to the formula:

$$\sigma = \Delta f * P_n * 100 / (f_n * \Delta P), [\%], \text{ where:}$$

ΔP - agreed FCR size with ESO EAD, MW;

P_n - rated power of the generating module, MW;

Δf - reference frequency deviation (0.2Hz);

f_n - rated frequency of the power system (50Hz).

2.5. The entire contracted FCR range shall be activated at the reference frequency deviation of $\pm 200\text{mHz}$, within 30s from start of the disturbance. The permissible active power overregulating is 10%.

2.6. If the frequency deviation in the grid exceeds $\pm 200\text{mHz}$, the activated FCR shall remain at the maximum contracted amount, i.e. there must be a limiter in the FCR function to prevent the power exceeding the range agreed with ESO EAD.

2.7. In the event of a frequency deviation above the reference value of $\pm 200\text{mHz}$, the generating module shall continue to provide the activated FCR, within the frequency range 47.5 to 51.5 Hz.

2.8. FCR is necessary during the entire time of frequency deviation from the set point occurs. The BSP must be able to provide FCR for the entire retention time set by ESO EAD, which shall be not less than 15min.

2.9. The FCR function must be able to be activated/desactivated by the BSP, at the request by ESO EAD dispatchers. The status of the FCR function shall be recorded by the control system of the generating module and transmitted to the SCADA/EMS of ESO EAD.

2.10. The dead band must be able to be activated/desactivated by the BSP without the assistance of external experts.

2.11. FCR testing shall be performed with a signal from a frequency simulator integrated in the control system or turbine regulator of the generating module which emulates the power system frequency for the duration of the test.

2.12. The manner and sequence of FCR testing procedure, shall be determined by ESO EAD. The pre-qualification test shall prove the technical capability of the generating module to fulfil the requirements of Art. 46 (para. 4, 5, 6, 7), Art. 96 and Art. 97 of the BG Grid Code and shall be carried out in the presence of an ESO EAD representative.

2.13. Monthly testing of the FCR of the generating module shall be automated so that the BSP staff can perform the tests without the assistance of external experts.

2.14. For the purpose of control and testing of the FCR, the control system of the generating module shall have a time synchronized SCADA system for data logging, visualization and storage. The SCADA system of the generating unit shall be capable of generating graphs (charts) in real time, with a resolution of not less than 1 point/sec. and a recording duration of at least 15min. The graphs must be documentable as a file and on paper. The basic quantities to be recorded are the following instantaneous values:

- simulated frequency, Hz;
- generating module load - measured, MW;
- generating module load – set point, MW.

2.15. The results of the tests shall be reported to ESO EAD in a document containing graphs and tables.

3. Technical information about the generating module

In addition to the information under Ordinance No.6 for connection of units to the electricity grid ESO may request additional technical information related to rated active power and full apparent power of the generating module, operational constraints, etc.

If BSP is a battery energy storage system (BESS), shall provide the following information as a minimum:

- Full energy storage capacity;
- Operational constraints that impact storage system usage;
- Instantaneous values of the available storage capacity;
- Maximum power and charge/discharge rate.

4. Procedure for the pre-qualification test

In the pre-qualification test, the following sequence shall apply:

4.1. In case all the information required under Art. 7 of the Tender rules for procuring frequency containment reserve, automatic (secondary control) frequency restoration reserve and manual (secondary control) frequency restoration reserve is provided, ESO EAD shall indicate to the BSP candidate periods within 45 days of application form approval in which the generating module may be tested.

4.2. The BSP candidate shall notify ESO EAD to the concrete date and time it shall be able to perform the pre-qualification test of the generating module within the periods specified in 4.1, at least one week in advance.

4.3. ESO EAD shall confirm the test period after notification. The test for the provision of the FCR shall be carried out in the presence of an ESO EAD representative.

4.4. If the testing plan is approved, the BSP candidate may proceed to testing. The BSP candidate shall be responsible for the costs incurred.

4.5. BSP candidate may cancel the pre-qualification test one day before the test. In this case, the BSP candidate must start the process again from step 4.1, unless otherwise agreed.

4.6. After the pre-qualification test, the BSP candidate and ESO EAD shall jointly prepare a protocol with the test results.

4.7. If all the required documentation is provided and the results in the protocol meet the requirements specified in this document, the generating module shall be entered in the BSP register for provision of FCR. If the requirements are not met, a request for a new test period shall be submitted by the BSP candidate, which shall make the necessary technical corrections, or the test of the generating module shall be considered failed.

5. Pre-qualification test process

The BSP candidate shall ensure that the generating module providing FCR meets the requirements specified in this document. The fulfilment of the requirements shall be verified in the presence of an ESO EAD representative, by successful completion of pre-qualification tests which shall be

conducted in a normal operating condition. The requirements and instructions given in this document shall be followed when performing the pre-qualification test.

During the test the generating unit shall be suspended from aFRR and mFRR, if this is necessary.

5.1. Pre-qualification test plan

5.1.1. Starting Conditions:

The generating module is individually controlled - active and reactive power control, by the control system.

The control system or turbine regulator of the generating module shall be set to pre-agreed FCR range and droop parameters with ESO EAD.

The active power set point for the test must be determined by ESO EAD representative and shall be set at a value that enables the delivery of the intended FCR in both directions.

The dead band shall be set to 0Hz.

The frequency measurement must be shifted from the main signal to a frequency simulator signal integrated in the control system or turbine governor of the generating module, which replaces the signal from the actual measured frequency in the power system for the duration of the test.

The frequency set point must be 50Hz.

FCR function must be on.

The SCADA system of the generating module shall be set up to record graphs (charts) in real time during the test.

The main values to be registered are the following instantaneous values:

- simulated frequency, Hz
- generated power output - measured, MW
- generated power output – set point, MW

5.1.2. Sensitivity check:

A system frequency change of -10mHz (-0.02%) must be simulated in order to monitor the response of the generating module. The test is considered successful if a visible increase in the power of the generating module is observed. The frequency set point must be returned to 50Hz.

A system frequency change of +10mHz (+0.02%) shall be simulated in order to monitor the response of the generating module. The test is considered successful if a visible decrease in the power of the generating module is observed. The frequency set point must be returned to 50Hz.

5.1.3. Verification of the FCR under the reference frequency disturbance:

A system frequency change of -200mHz (-0.4%) must be simulated. The test shall be considered successful if the output power of the generating module is increased in mirroring the frequency decrease by the entire contracted FCR range, with an activation time no greater than 30 seconds and no overregulating more than 10%. The reduced frequency must be maintained for a minimum

of 15min and the stability of the output power of the generating module must be monitored. The frequency set point must be returned to 50Hz.

A system frequency change of +200mHz (+0.4%) must be simulated. The test shall be considered successful if the output power of the generating module is reduced mirroring the frequency increase by the entire contracted FCR range, with an activation time no greater than 30 seconds and no overregulating more than 10%. The increased frequency shall be maintained for a minimum of 15min and the stability of the output power of the generating module must be monitored. The frequency set point must be returned to 50Hz.

5.1.4. Dead band check:

Deadband must be set to $\pm 100\text{mHz}$ (0.2%).

A system frequency change of -200mHz (-0.4%) must be simulated. The test shall be considered successful if the output power of the generating module increases mirroring the frequency decrease by half of the contracted FCR range. The frequency set point must be returned to 50Hz.

A system frequency change of +200mHz (+0.4%) must be simulated. The test shall be considered successful if the output power of the generating module is lowered mirroring the frequency increase by half of the contracted FCR range. The frequency set point must be returned to 50Hz.

The dead band shall be set to 0Hz.

5.1.5. Verification of the FCR size limit:

A system frequency change of -300mHz (-0.6%) must be simulated. The test shall be considered successful if the output power of the generating module increases mirroring the frequency decrease, not exceeding the contracted FCR range. The frequency set point must be returned to 50Hz.

A system frequency change of +300mHz (+0.6%) must be simulated. The test shall be considered successful if the output power of the generating module decreases mirroring the increase in frequency, not exceeding the contracted FCR range. The frequency set point must be returned to 50Hz.

5.1.6. Restoring the generating unit's main operational scheme:

The frequency measurement in the control system or turbine governor of the generating unit shall be reset to the preset frequency signal. The dead band value shall be determined by ESO EAD.

5.2. Documentation of the results of the pre-qualification test

The final results of the pre-qualification test shall be recorded in two identical copies, which shall be signed by persons authorized for this purpose by ESO EAD and by the BSP candidate.

The protocols have the following requisites:

- Date compiled;
- Date and time of the test;

- Name of the BSP candidate;
- The application number for the BSP candidate's pre-qualification test.
- Basic parameters of the generating module of the BSP candidate that has been tested with its corresponding EIC;
- Measured values and graphs (charts);
- Results of the verification of the communication connectivity with the SCADA/EMS system of ESO EAD;
- Conclusion of the test - entry in the register or refusal to register of the BSP;
- The control of the participating BSP in the FCR shall be performed according to the values of the parameters registered by the SCADA/EMS system of the ESO EAD, the recording systems of the generating module and the recorders in the substation of ESO EAD.

5.3. Validity of test results

The validity period of the recorded results from the pre-qualification test is unlimited, once the generating module has passed it successfully.

A new prequalification shall be required to increase or decrease the FCR range, or after a refurbishment of the generating unit. By the fifth day of each month or in the cases of first start-up after installation or each overhaul of the module, the BSP by itself or in the presence of ESO EAD representative, shall perform a test to demonstrate the technical parameters. These tests shall be performed on a limited basis, relative to the pre-qualification test plan, and shall exclude the verification of the dead band and the verification of the FCR range. The results of the tests shall be sent by e-mail to the ESO EAD experts in the form of graphs and a report containing in tabular form with the achieved parameters and time stamps of the tests.

6. Control and payments for the participation in FCR

6.1. By the fifth day of each month or in the cases of first start-up after installation or each overhaul of the module, the BSP by itself or in the presence of ESO EAD representative, shall perform a test to demonstrate the technical parameters by which the module participates in FCR process. The test must be carried out between 08:00 and 16:00 on a working day and the results, in the form of a report and graphs, shall be submitted by e-mail to ESO EAD within five working days after the test.

6.2. If these results confirm the parameters in Table 1, it is assumed that the module is effectively involved in FCR.

6.3. If during the test, any of the parameters shall not correspond to those specified in Table 1, the BSP must suspend the FCR function of the module and shall immediately submit a request to the ESO EAD indicating the reasons and the period for their suspension and eventual restoration to normal FCR operation.

6.4. The BSP shall be paid for the participation of the module in FCR for each previous month. The total payment shall be calculated as the time in hours for which the module has participated in FCR multiplied by the FCR price for each market time period. The time of module participation in FCR shall be recorded in a protocol, based on the backup data from the control system of the BSP, summing up the periods in which FCR is activated. This protocol shall be prepared after the end of each month by the BSP and sent to ESO EAD by e-mail for review and approval.

6.5. At each restoration or suspension of the module from the FCR process, the BSP shall inform ESO EAD explaining the reason for this. ESO shall record the data provided by the BSP in the operational log.

6.6. ESO EAD shall inform the BSP of any case of registered deficient participation in FCR.

II. Technical requirements for automatic frequency restoration reserve (aFRR) - conditions and parameters

1. Technical characteristics defined by the standard product

1.1. Static characteristics

Characteristic	Value	Description
Full activation time	No more than 5 minutes from 18.12.2024 and no more than 7.5 minutes until 18.12.2024.	This is the period between the activation order submitted by the SCADA/EMS and full activation of the standard product by the BSP
Deactivation period	$\leq$ Full activation time	The period from full delivery back to the original operating set point before activation
Minimum bid size	1 MW	Minimum bid size by BSP
Maximum bid size	9999 MW	Maximum bid size by BSP
Bid resolution	1 MW	The possible modification of bids over their minimum size.
Validity period	15 minutes	The period in which balancing energy bid offered by the BSP can be activated, provided that all the characteristics of the standard product are met. The period for which a bid is valid and non-modifiable. The first validity period for each day starts at exactly 00:00 market time. Validity periods are consecutive and do not overlap.
Activation	By dispatcher's order or through set point command by SCADA/EMS communication protocol	Standard product activation method.
Deactivation	By dispatcher's order or through set point command by SCADA/EMS communication protocol	Standard product deactivation method.

1.2. Variable characteristics

Characteristic	Description
Quantity	MW
Direction	Positive and negative
Validity period	The period for which the standard aFRR product is valid

1.3. Additional characteristics

Characteristic	Description
Bid divisibility	aFRR bids are divisible, so it is possible to activate only part of the bid (even less than the minimum bid size).
Activation/Deactivation	aFRR bids can be activated and deactivated at any time during the valid period
Minimum delivery time	aFRR bids have no minimum required time between activation and deactivation within a validity period.
Precision	According to Art. 98, para 3, subpara. 3 of the BG Grid Code
Auto-consumption of modules/units	Applies when the modules/units of the BSP are governed by gross power or in case of energy storage systems.

2. General conditions for participation in aFRR

2.1. Fulfilment of real-time information exchange requirements.

2.2. Participation in the aFRR process shall be in accordance with the requirements of Art. 98 of the BG Grid Code and Regulation (EU) 2017/1485.

2.3. A module/unit providing reserve successfully participates in the aFRR process when its active power output is set by the central regulator (SCADA/EMS) of ESO EAD and through telecommunication and telemechanics means is automatically transmitted to and executed by the unit/module in accordance with the set control parameters (operating range, ramp rate and set point reaction delay), and the set point precision is within the agreed range without requiring additional adjustments.

2.4. The "aFRR operating range" of a module/unit in terms of active power is the difference between the maximum and minimum active powers within which the module/unit can operate without limitation during the period of validity of the bid when it is under the control of the central regulator. The operating ranges and other technical parameters of each module/unit supplying aFRR for winter and summer periods are set out in the table in Section 3 below. If necessary, the BSP of the module/unit may negotiate with ESO EAD dispatcher on shift changes to the operating ranges, depending on the technical characteristics of the BSP. These modifications shall not restrict the execution of the bids offered by the BSP. The same modifications shall be taken into account when determining the capacity payment amount for the aFRR reserve. The dispatcher on shift shall set the lower and upper limits of the SCADA/EMS within the operating range.

2.5. "Ramp rate" is the technologically determined active power change limited by the automation of the module/unit providing aFRR

2.6. "Active power set point delay" is the difference between the actual time the module/unit reaches the set point and the time at which the central regulator has issued the command for this set point.

2.7. "Set point precision" in % is the ratio of the difference between the realized active power and the set point after the completion of the transient process and shall comply with the requirements in Art. 98, para. 3, subpara. 3 of the BG Grid Code.

2.8. "Simultaneously provision of FCR, aFRR and/or mFRR" - in addition to providing the aFRR, the modules/units may also participate in providing FCR and mFRR. This applies if the provision of these two services does not jeopardise the provision of the aFRR and vice versa.

2.9. The "participation period" of a module/unit providing aFRR is the time interval during which a module/unit participates in aFRR process. The start of the period shall be counted after feedback from the module/unit is received by ESO EAD that the said module/unit has switched to active power remote control and after ESO EAD dispatcher has set the control mode of the module/unit.

2.10. "Suspension period" - starts after order of the dispatcher on shift of ESO EAD to suspend the remote control, reflecting it in the dispatch log. This occurs when two consecutive lockouts within a 15-minute interval are registered. The lockout process is initiated by an accumulated integral error in the execution of the set-point (the lockout is automatically executed by the SCADA/EMS) or by an alarm signal sent by a module/unit providing aFRR for a failure in its control system, as well as manually by the operator of the module/unit. Restoration of the module into remote aFRR control is at the request of the operator (of the module/unit) to the dispatcher on shift of ESO EAD.

2.11. "Means for control and registration of the participation of the modules/units in the aFRR" - the control of the participation of each module/unit providing reserve for aFRR is verified by the parameters values registered by the SCADA/EMS of ESO EAD.

3. Parameters for participation in aFRR:

The operating ranges and other technical parameters of each module/unit providing aFRR for winter and summer periods shall be indicated in the table below. If necessary, the operator of the module/unit may negotiate operational changes to these ranges with the dispatcher on shift. These modifications shall be taken into account when determining the final payment to the BSP.

module/unit providing reserve	Operating range with FCR		Operating range without FCR		Ramp rate	Reaction delay	Accuracy
	winter 01.01- 31.03 and 01.10-31.12	Summer 01.04-30.09	winter 01.01- 31.03 and 01.10-31.12	Summer 01.04-30.09			
№	[MW]	[MW]	[MW]	[MW]	[MW/min]	[min]	[%]
1							
...							

4. Technical requirements to the BSP for aFRR

4.1. Activation signal transmission process

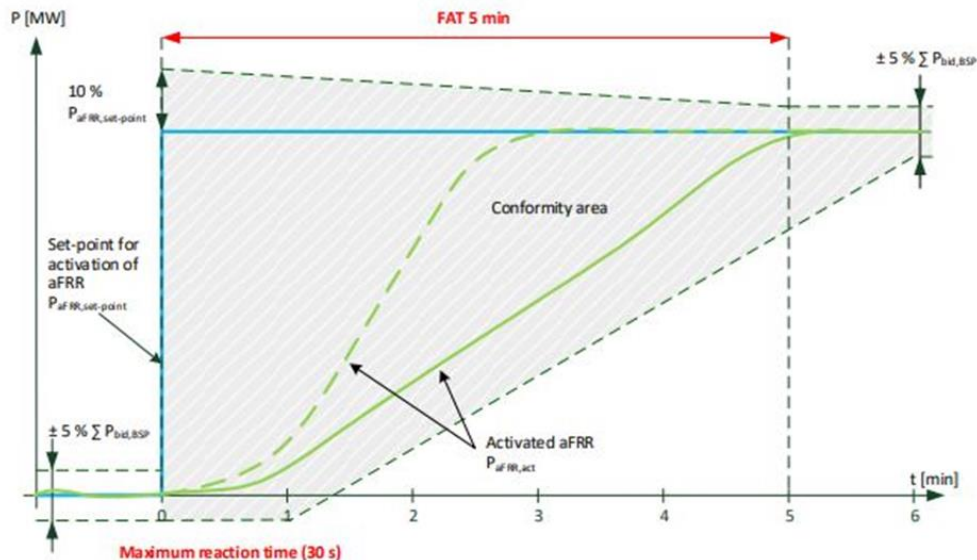
The active power required for frequency restoration of the power system is calculated by SCADA/EMS at ESO EAD or by a centralised balancing platform covering the participating TSOs, which sends an activation request to the connecting TSO (ESO EAD). In the latter case, the ESO EAD shall forward the activation request to the BSP.

The activation signal process is as follows:

- BSP sends to the SCADA/EMS of ESO EAD, the power for self-consumption of modules/unit, in case of gross power control or when BESS is involved.
- Based on a local or general procedure for activation of market bids (merit order), the SCADA/EMS sends a signal indicating the new set point to the BSP, which forwards the signal to the providing aFRR modules/units belonging to the ESO EAD control area.
- The BSP may use a different mix of modules/units within the ESO EAD control area, as long as they are consistent with the standard aFRR product. Multiple combinations of the same units/modules may be requested for approval. In any case, the BSP shall be responsible for providing balancing energy.

4.2. Ramp rate

The module/unit involved in the aFRR shall fully activate its reserve capacity within 5 minutes of the activation signal being sent. Activation shall start no later than 30 seconds after the activation signal has been sent. There is no requirement for additional delay before the execution of the ramping. This delay is intended to facilitate any technical limitations of the module/unit. The recommendation is to start the ramping as soon as possible and use either a fixed ramp rate or a dynamic ramp rate, ensuring at least the minimum ramp rate. Actual activation of the reserve capacity shall be at a rate equal to or above the minimum ramp rate. There shall be no limit to the maximum ramp rate.



4.3. Requirements for energy storage systems

Each BSP with energy storage systems shall provide comprehensive information on the following points:

- Full energy storage capacity;
- Operational constraints that impact storage system usage;
- Operating capacity of the storage system;
- Maximum allowed charge/discharge power;
- Description of the strategic planning system for the storage system control;
- Information on the extent of use of the strategic planning system (continuously, every 5 minutes, etc.);
- Expected regularity and size of the bids.

5. Procedure for the pre-qualification test

In the pre-qualification test, the following sequence shall be applied:

5.1. In case all the information required under Article 7 of the Tender rules for procuring frequency containment reserve, automatic frequency restoration reserve and manual frequency restoration reserve is provided, ESO EAD shall indicate to the BSP candidate the periods within 45 days of application approval in which the modules/units may be tested.

5.2. The BSP candidate shall notify ESO EAD to the concrete date and time it shall be able to perform the pre-qualification test of the generating unit within the periods specified in 5.1, at least one week in advance.

5.3. ESO EAD shall confirm the test period after receiving notification.

5.4. If the testing plan is approved, the BSP candidate may proceed to testing. The BSP candidate shall be responsible for the costs incurred by the testing

5.5. The BSP candidate may cancel the pre-qualification test up to one hour prior to the test. If there is no option to conduct the test at a later stage during the allocated timeframe, then the BSP candidate shall start the process again from step 5.1 unless otherwise agreed.

5.6. After the end of the pre-qualification test, the BSP candidate and ESO EAD shall share the test results with each other.

5.7. ESO EAD shall analyse the pre-qualification test data no later than one week after exchanging the test results. If all required documentation has been provided and the results meet the requirements set out in this document, ESO EAD and the BSP candidate shall sign a protocol with the achieved parameters from the test results and the candidate shall be entered into the BSP register. If the requirements are not met, a request for a new test period shall be submitted by the BSP candidate, which shall make the necessary corrections, or the test shall be deemed failed.

6. Pre-qualification test process

The BSP candidate shall ensure that the unit/module providing aFRR meets the requirements specified in this document. The fulfilment of the requirements shall be verified by means of pre-qualification tests which shall be carried out in normal operating conditions of the unit/module. The requirements and guidelines given in this document shall be followed when conducting the pre-qualification test.

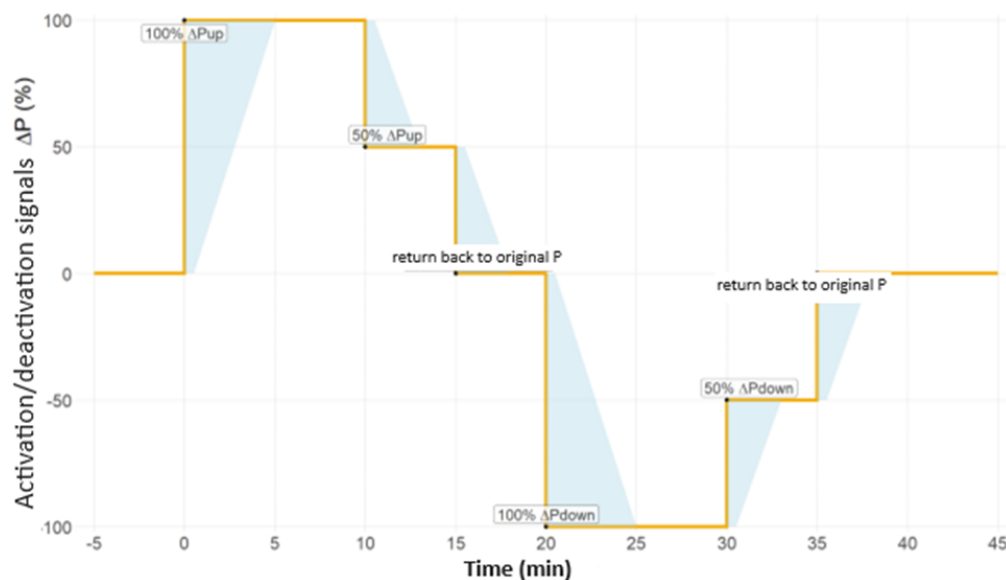
The BSP candidate shall define the maximum values to be tested for upward and downward regulation as ΔP_{up} (up) and ΔP_{down} (down) respectively. ESO EAD shall send activation signals according to the test sequence presented in the table in section 6.1.

During the test, the units/modules to be tested shall be suspended temporarily from participation in FCR and/or mFRR, if it is necessary.

The units/modules tested must meet the requirements described in this document.

6.1. Pre-qualification test plan

Time (minutes)	Set point change (% of ΔP)
-5	Test start (systems and measurements are active)
0	100% ΔP_{up} activation signal, including self-consumption power where applicable
5	Maintaining the assignment
10	New set point signal of 50% ΔP_{up} , including self-consumption power where applicable
15	Return to the initial set point at the start of the test
20	100% ΔP_{down} activation signal, including self-consumption power where applicable
25	Maintaining the assignment
30	New set point signal of 50% ΔP_{down} , including self-consumption power where applicable
35	Return to the initial set point at the start of the test
40	End of test



6.2. Documenting the results of the pre-qualification test

The results of the pre-qualification test shall be recorded in two identical copies, which shall be signed by persons authorised for this purpose by ESO EAD and the BSP candidate. The protocols shall have the following requisites:

- Date compiled;
- Date and time of the test;
- Name of the BSP candidate;
- The application number for the BSP candidate's pre-qualification test;
- Basic parameters of the modules of the BSP candidate that have been tested with their corresponding EIC;
- Realized active power values in tabular form according to the order in the table in Section 6.1. with a time resolution of 30 seconds;
- The recorded values of the parameters test;
- Communication connectivity result;
- Result in regard to the reception and transmission of a communication signal;
- Result in regard to the performance when executing an activation signal in both directions;
- Conclusion from the test - entry into the BSP register or refusal.

The participation control of each module/unit aFRR shall be verified by the values of the parameters recorded by the SCADA/EMS of ESO EAD. In case of disagreement, data from data loggers of the module/unit providing aFRR may also be used.

6.3. Validity of test results

The period of validity of the recorded results from the pre-qualification test is unlimited once the units/modules have passed it.

A new pre-qualification procedure is required to increase or decrease the maximum operating range of aFRR (both up and down). Changes in the unit/module portfolio of a BSP do not automatically result in a new pre-qualification procedure if the previous technical capability is maintained.

ESO EAD shall reserve the right to carry out additional functional tests of the modules/units to verify if the technical requirements are met, without prior notification to the BSP. This may be done either by requesting specific operational tests (e.g. by introducing additional test signals during the technical qualification procedure) or during the normal operation of the module/unit when providing aFRR. When performing the testing, ESO EAD shall consider the candidate's commercial delivery schedule and organisational constraints to the maximum extent possible. For the purpose of testing, the candidate shall make all necessary arrangements (e.g. preparation of measurement and analysis systems) and actively support ESO EAD in conducting the test itself.

The BSP is required to monitor its modules/units on a continuous basis and to immediately inform ESO EAD if they are unable to fully meet their contractual obligations relating to the provision of aFRR.

III. Technical requirements for manual frequency restoration reserve (mFRR)–conditions and parameters

1. Technical characteristics defined by the standard product

1.1. Static characteristics

Characteristic	Value	Description
Full activation time (FAT)	Not more than 12.5 (12:30) minutes	This is the time between the activation order sent by the dispatcher on shift of ESO EAD and the corresponding full activation of the standard product by the BSP.
Delay of the reaction	No more than 2.5 (2:30) minutes	Part of the full activation time. This is the period between the activation order given by the dispatcher on shift of ESO EAD and the ramping of the power output of the BSP's modules or the moment of receiving the response signal in the SCADA/EMS of ESO EAD.
Ramping time	No more than 10 minutes	Part of the full activation time. This is the time from the start of the power output ramping until the moment the set point assigned by the SCADA/EMS of ESO EAD is reached.
Minimum retention time of the set point power	Minimum 5 minutes	This is the period from the moment the set point is reached until deactivation is started.
Deactivation time	$\leq$ FAT	The ramping period from full delivery back to the original operating set point prior to activation in accordance with the commercial schedule of the unit.
Maximum bid size	9999 MW	Maximum size of the bid offered by the BSP
Minimum bid size	1 MW	Minimum size of the bid offered by the BSP

Bid resolution	1 MW	The BSPs can change their bid by a multiple of this quantity between min and max bid size
Validity period	15 minutes	The period during which the balancing energy bid made by the BSP can be activated, provided that all the features of the standard product are met or the period for which a bid is valid and non-modifiable. The first period of validity for each day starts at 00:00 market time unit. Validity periods are consecutive and do not overlap.
Activation	By dispatcher's command or through set point signal using SCADA/EMS communication protocol	Standard product activation method
Deactivation	By dispatcher's command or through set point signal using SCADA/EMS communication protocol	Standard product deactivation method

1.2. Variable characteristics

Characteristic	Description
Quantity	MW
Direction	Positive and negative
Validity period	The period for which the standard mFRR product is valid.

1.3. Additional characteristics

Characteristic	Description
Asymmetry	Separate price and quantity bids are available for down and up directions
Divisibility	mFRR bids are divisible, so it is possible to activate only part of the bid
Activation/Deactivation	mFRR offers can be activated and deactivated at any time during the period for which they are valid.
Performance	Pursuant to Art. 98, par. 3, subpara. 3 of the BG Grid Code
Self-consumption	Applies when the BSP modules/units are governed by gross power or energy storage systems are involved.

2. General conditions for participation in mFRR

2.1. The BSP shall fulfil the requirements of real-time information exchange.

2.2. The BSP shall participate in the mFRR process, including the balancing of sources with variable generation, in accordance with the requirements of Art. 98 of the BG Grid Code and of EC Regulation (EU) 2017/1485.

2.3. A module/unit providing reserve shall fully participate in the mFRR process when its ramp rate complies with Art. 98, par. 3, subpara. 2 of the BG Grid Code, and in the case of non-described technologies the ramp rate must be greater than or equal to 0.08 MW/minute.

2.4. The performance (the accuracy of execution) of the assignment shall comply with the requirements in Art. 98, par. 3, subpara. 3 of the BG Grid Code.

2.5. The module/unit shall be eligible to provide mFRR to balance variable generation when its ramp rate is greater than 10MW/minute.

2.6. The operating ranges and other technical parameters of each module/unit providing mFRR for winter and summer periods are listed in the table in Section 3 below. If necessary, the module/unit operator may negotiate changes to these parameters with the dispatcher on shift at ESO EAD. These modifications shall be considered when calculating the settlement payment to the BSP.

3. Parameters for participation in mFRR

The operating ranges and other technical parameters of each module/unit providing mFRR for winter and summer periods are listed in the table below. If necessary, the module/unit operator may negotiate changes to these parameters with the dispatcher on shift at ESO EAD. These changes shall be considered when calculating the settlement payment to the BSP.

module/unit providing reserve	Operating range with FCR		Operating range without FCR		Ramp rate	Reaction delay	Accuracy
	Winter 01.01-31.03 and 01.10-31.12	Summer 01.04-30.09	Winter 01.01-31.03 and 01.10-31.12	Summer 01.04-30.09			
№	[MW]	[MW]	[MW]	[MW]	[MW/min]	[min]	[%]
1							
...							

4. Technical requirements to the BSP for mFRR

4.1. Activation signal transmission process

The active power required to restore the power system frequency is determined by

a. dispatcher on shift at ESO EAD;

or

b. a centralised platform covering the participating TSOs, which sends an activation request to the connecting TSO (ESO EAD). In the second case, the ESO EAD forwards the activation request to the BSP.

The activation signal process shall go as follows:

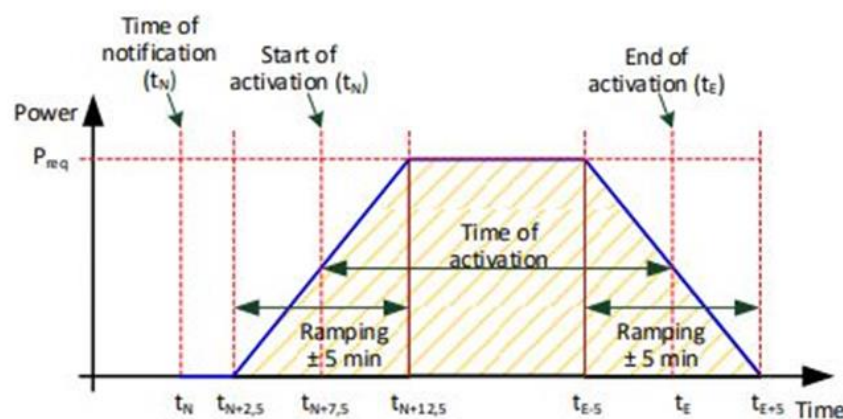
- The BSP, through its control systems sends to the SCADA/EMS of ESO EAD, power for self-consumption, in the case of gross power control or when energy storage systems are involved.

- Based on a local or general procedure for activating market bids (merit order), ESO EAD activates an offer:
 - by telephone through the dispatcher on shift
 or
 - by sending a signal indicating the new set point to the BSP control system, which forwards the signal to the modules/units providing mFRR within the control area of ESO EAD.
- The BSP may use a diverse portfolio of modules/units within the ESO EAD control area, as long as they are compliant with the mFRR standard product. In any case, the BSP shall be solely responsible for provision of balancing energy.

4.2. Ramp rate

The module/unit participating in the mFRR shall fully activate its reserve capacity within 12,5 minutes of sending the activation signal/order. Activation shall start no later than 2 minutes and 30 seconds after the activation signal/order has been sent. The activation time shall be taken as the time from the order to transfer the remote control over to the ESO EAD dispatcher until its registration in the SCADA/EMS.

There is no requirement for additional delay before the start of the ramping. This optional delay is intended to facilitate any technical limitations of the module/unit. The recommendation is to start the ramping as soon as possible and use either a fixed ramp rate or a dynamic ramp rate, ensuring the at least the required minimum ramp rate. Actual activation shall happen at a ramp rate equal to or above the minimum required.



4.3. Requirements for energy storage systems

Each BSP with energy storage systems in its portfolio shall provide comprehensive information on the following points:

- Full energy storage capacity
- Operational constraints that impact storage system usage;
- Operating capacity of the storage system;
- Maximum allowed charge/discharge power;

- Description of the system for strategic planning of the storage system operation;
- Information on the extent of use of the strategic planning system (continuously, every 5 minutes, etc.);
- Expected regularity and size of bids.

5. Procedure for the pre-qualification test

In the pre-qualification test, the following sequence shall be applied:

5.1. In case all the information required under Art. 7 of the Tender rules for procuring frequency containment reserve, automatic frequency restoration reserve and manual frequency restoration reserve is provided, ESO EAD shall indicate to the BSP candidate the periods within 45 days of application in which the modules/units may be tested.

5.2. The BSP candidate shall notify ESO EAD to the concrete date and time it shall be able to perform the pre-qualification test of the generating unit within the periods specified in 5.1, at least one week in advance.

5.3. ESO EAD shall confirm the test period after receiving notification.

5.4. If the testing plan is approved, the BSP candidate may proceed to testing. The BSP candidate shall be responsible for the costs incurred by the testing

5.5. The BSP candidate may cancel the pre-qualification test up to one hour prior to the test. If there is no option to conduct the test at a later stage during the allocated timeframe, then the BSP candidate shall start the process again from step 5.1 unless otherwise agreed.

5.6. After the end of the pre-qualification test, the BSP candidate and ESO EAD shall share the test results with each other.

5.7. ESO EAD shall analyse the pre-qualification test data no later than one week after exchanging the test results. If all required documentation has been provided and the results meet the requirements set out in this document, ESO EAD and the BSP candidate shall sign a protocol with the achieved parameters from the test results and the candidate shall be entered into the BSP register. If the requirements are not met, a request for a new test period shall be submitted by the BSP candidate, which shall make the necessary corrections, or the test shall be deemed failed.

6. Pre-qualification test process

The BSP candidate shall ensure that the unit/module providing mFRR meets the requirements specified in this document. The fulfilment of the requirements shall be verified by means of pre-qualification tests which shall be carried out in normal operating conditions of the unit/module. The requirements and instructions given in this document shall be followed when performing the pre-qualification test.

BSP candidate shall define the maximum values to be tested for upward and downward balancing as ΔP_{up} (up) and ΔP_{down} (down) respectively. ESO EAD shall send activation signals/commands according to the test sequence presented in the table in section 6.1. The test shall be performed in both directions.

During the test, the units/modules shall be suspended from participation in FCR and aFRR process, if necessary.

The tested units/modules must meet the requirements described in this document.

6.1. Pre-qualification test plan

Time (minutes)	Set point change (% of ΔP)
-5	Test start (systems and measurements are active)
0	Signal/command to activate 100% ΔP , including self-consumption where applicable
$\leq 2,5$	Start of ramping up/down
$\leq 12,5$	Achieving 100% ΔP , including self-consumption where applicable
17,5	Signal to return to the initial operating set point at test start
≤ 30	Reaching the initial operating set point at test start
30	End of test

6.2. Documentation of the results of the pre-qualification test

The results of the pre-qualification test shall be recorded in two identical copies, which shall be signed by persons authorised for this purpose by ESO EAD and the BSP candidate. The protocols shall have the following requisites:

- Date compiled;
- Date and time of the test;
- Name of the BSP candidate;
- The application number for the BSP candidate's pre-qualification test;
- Basic parameters of the modules of the BSP candidate that have been tested with their corresponding EIC;
- Realized active power values in tabular form according to the order in the table in Section 6.1. with a time resolution of 30 seconds;
- The recorded values of the parameters;
- Communication connectivity result;
- Result in regard to the reception and transmission of a communication signal;
- Result in regard to the performance when executing an activation signal in both directions;
- Conclusion from the test - entry into the BSP register or refusal.

The control of each module/unit providing mFRR is performed according to the parameter values entered in the SCADA/EMS of ESO EAD. In case of disagreement, data from the data loggers of the module/unit providing mFRR may also be used.

6.3. Validity of the test results

The validity period of the recorded results of the pre-qualification test is unlimited once the units/modules have passed it successfully.

A new pre-qualification procedure is required to increase or decrease the maximum operating range of mFRR (both up and down). Changes in the unit/module portfolio of a BSP do not automatically result in a new pre-qualification procedure if the previous technical capability is maintained.

ESO EAD shall reserve the right to carry out additional functional tests of the modules/units to verify if the technical requirements are met, without prior notification to the BSP. This may be done either by requesting specific operational tests (e.g. by introducing additional test signals during the technical qualification procedure) or during the normal operation of the module/unit when providing mFRR. When performing the testing, ESO EAD shall consider the candidate's commercial delivery schedule and organisational constraints to the maximum extent possible. For the purpose of testing, the candidate shall make all necessary arrangements (e.g. preparation of measurement and analysis systems) and actively support ESO EAD personnel in conducting the test itself.

The BSP is required to monitor its modules/units on a continuous basis and to immediately inform ESO EAD if they are unable to fully meet their contractual obligations relating to the provision of mFRR.

IV. Real-time information transfer requirements

1. General requirements for real-time information to FCR, aFRR and mFRR providers

1.1. BSPs must have real-time communication via IEC60870-5-104 protocol or existing interface with the SCADA/EMS of ESO EAD.

1.2. BSPs that are directly connected to the transmission network of ESO EAD and have an established real-time communication may use the existing communication line described in their respective contract for access to the transmission grid.

1.3. BSPs which are aggregators and have an already established real-time communication from at least one of their aggregated units/modules with the SCADA/EMS of ESO EAD may use this existing communication connection, described in the relevant access contract. It is mandatory to provide IEC60870-5-104 communication on the aggregated portfolio independent of the real-time communication from each stand-alone unit/module.

1.4. BSPs that do not have real-time communication in place may use either of the following two options:

a) Option 1:

Fiber optic communication line or dark fiber lease to a pre-agreed ESO substation, including necessary network equipment, IPsec VPN tunnel capability.

b) Option 2:

Communication line via GPRS modem with built-in firewall, with the possibility of adding an IPsec VPN tunnel of a pre-agreed type with ESO EAD.

Only Option 1 shall be allowed for BSPs providing only aFRR or aFRR in combination with FCR and/or mFRR. For BSPs providing only FCR or mFRR or a combination of both services, Option 1 or Option 2 shall be allowed.

1.5. BSP must meet the communication criteria (communication protocols, information exchange, etc.) defined by ESO EAD before the start of the pre-qualification tests. They must comply with ESO EAD standards for real-time information exchange communication protocols (<https://www.eso.bg/doc?463>).

1.6. The data shall be transferred according to ESO EAD standards for real-time information exchange and shall be transmitted spontaneously on each value change and also cyclically, with a cycle no greater than 10 seconds. The precision of the measurements shall be higher or equal to 0.5%. Tele-signals shall be transmitted at the time of registration in the local event log of the control system of the BSP with a delay not more than 10 msec.

1.7. Failure to provide the required communication means and resources will result in suspension of access to the tendering procedures or exclusion from the BSP register pursuant to Article 10 of the tender Rules.

1.8. Conducting pre-qualification tests require operational communication between SCADA/EMS of ESO EAD and the BSP's control system of the modules/units with all the signals specified by ESO EAD.

1.9. All signals used in the test are logged by the SCADA/EMS of ESO EAD.

1.10. The communication links and the information transferred over them shall be kept continuously active regardless of whether the BSP is qualified to provide balancing services for the balancing period concerned. This shall ensure that the communication link for data exchange is prepared and can be used for activation request at any time without having to be checked or tested again. A unilateral interruption of the data link by the BSP, which is not agreed with ESO EAD, shall result in the BSP's units/modules being temporarily blocked from the merit order list. The reconnection shall be done by retesting the communication system and channels, after which it shall be possible to activate the BSP's units/modules from the merit order again.

1.11. The signals listed in the next paragraphs describe the minimum requirements. ESO EAD shall reserve the right to request additional signals in real time, and the BSP is obliged to provide them.

2. Specific real-time information requirements to FCR providers

2.1. Participation in FCR shall be done in accordance with Art. 97 of the BG Grid Code and EC Regulation (EU) 2017/1485.

2.2. The quality of FCR shall be subject to monthly demonstration through testing or verification in the event of a disturbance in the power system, based not only on real-time information.

2.3. BSP shall provide data for the specific unit/module to the SCADA/EMS of ESO EAD as follows:

- a) instantaneous operating power, MW. The data type shall be a measurement sent from the BSP system.

- b) FCR status - on/off. The data type shall be a single point sent by the BSP system.
- c) size of FCR in MW to be provided. The data type shall be a measurement sent by the BSP system.
- d) frequency measured by the control system of the BSP, in Hz (three decimal slots accuracy). The data type shall be a measurement sent by the BSP system.
- e) instantaneous available charging and discharging capacity of the energy storage system - aggregate and/or per module, MWh. The data type shall be a measurement sent by the BSP system. Only applicable to units/modules with an energy storage system.

3. Specific real-time information requirements to aFRR providers

3.1. Participation in aFRR shall be done in accordance with the requirements of Art. 98 of the BG Grid Code and EC Regulation (EU) 2017/1485.

3.2. BSP shall provide data for the specific unit/module to the SCADA/EMS of ESO EAD as follows:

- a) instantaneous operating power, MW. The data type is a measurement sent from the BSP system.
- b) signal from the switching devices of the BSP. The data type shall be e-bit or two-bit signal sent from the BSP system.
- a) remote control - on/off. The data type shall be a single or double point information sent from the BSP system.
- b) active power set point signal, MW. The data type shall be a set point command sent by SCADA/EMS of ESO EAD.
- c) active power setpoint from the BSP system, MW. The data type shall be a measurement sent by the BSP system (confirmation of the value received with the set point command).
- c) Self-consumption power - applies in cases where the modules/units are operated by gross power control or energy storage systems are involved. The data type shall be a measurement sent from the BSP system.
- d) instantaneous maximum and instantaneous minimum power, MW. The data type shall be a measurement sent by the BSP system.
- e) instantaneous available charging and discharging capacity of the energy storage system - aggregate and/or per module, MWh. The data type shall be a measurement sent by the BSP system. Only applicable to units/modules with an energy storage system.
- f) instantaneous available capacity of the energy storage system for charge/discharge for the relevant trading interval - aggregate and/or per module, MWh. The data type shall be a measurement sent by the BSP system.

- g) ramp rate during execution of the assignment - MW/min, if agreed between BSP and ESO EAD. The data type shall be a measurement sent by the BSP system.

4. Specific requirements for real-time information to mFRR providers

4.1. Participation in mFRR shall be done as required by Art. 98 of the BG Grid Code and EC Regulation (EU) 2017/1485.

4.2. BSP shall provide data for the specific unit/module to the SCADA/EMS as follows:

- a) instantaneous operating power, MW. The data type shall be a measurement sent by the BSP system.
- b) active power set point signal, MW. This shall be a positive number when activated to increase power above the commercial schedule and a negative number when activated to decrease power below the commercial schedule, in MW. For deactivation, a set point signal of zero (0) is sent as per protocol. The data type shall be a set point command sent by the SCADA/EMS.
- c) c) active power setpoint from the BSP system, MW. The data type shall be a measurement sent by the BSP system (confirmation of the value received with the set point command).
- a) Set point readiness signal. The BSP shall be responsible to activate this signal during the market periods for which there is a bid placed. No provision of this signal shall be considered as failure to fulfil an activation request. The data type shall be a single point information sent by the BSP system.
- b) Self-consumption power - applies in cases where the modules/units are operated by gross power control or energy storage systems are involved. The data type shall be a measurement sent from the BSP system.
- c) instantaneous available charging and discharging capacity of the energy storage system - aggregate and/or per module, MWh. The data type shall be a measurement sent by the BSP system. Only applicable to units/modules with an energy storage system.
- d) ramp rate during execution of the assignment - MW/min, if agreed between the BSP and ESO EAD. The data type shall be a measurement sent by the BSP system.