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FCR Manual for BSP's

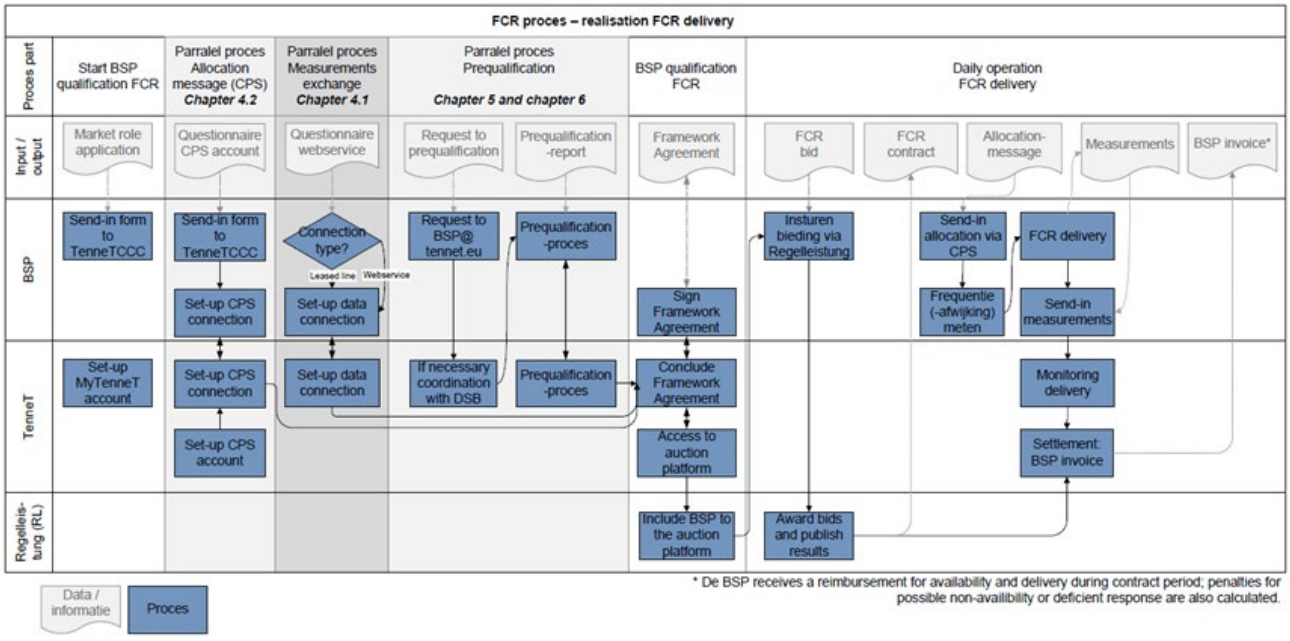
Requirements and procedures for supply of FCR

Foreword and guide

The frequency within the synchronous area of continental Europe has a nominal set point of 50 Hz. Deviations in frequency in respect of this set point are normal and are part of standard operation. The purpose of Frequency Containment Reserves (FCR) is to limit and stabilise frequency deviations in the entire synchronously connected high-voltage grid (both national and international), regardless of the event and location of the imbalance that caused them. Without adequate intervention, frequency deviations may lead to automatic load shedding and even cause a black-out in the worst case scenario.
The minimum level of FCR contributions required from each control area is agreed annually within the European Network of Transmission System Operators for Electricity (ENTSO-E) of the Regional Group Continental Europe. The individual values are determined in proportion to the total electricity production in the control area of each connected TSO.

A lot of information and requirements are based on European directives and Dutch grid code. Also legislation is described in ENTSO-e's SAFA[1] Annex 1: Policy on Load-Frequency Control and Reserves.

This document is built up by different chapters whose sequence follows the FCR process as closely as possible. A description of FCR supply with various compositions of units can be found in chapter 2. This is followed by the product specifications for FCR and the information that must be exchanged with TenneT in chapters 3 and 4. Chapter 5 sets out the prequalification process together with the corresponding description of the prequalification tests in chapter 6. Finally, requirements and information regarding the auction are described in chapter 7.



[1] Synchronous Area Operational Agreement for the Synchronous Area CE

Table of Contents

Version history

The document is split up into different chapters that describe the specific elements of the FCR and FCR supply. To clarify what has been amended in each chapter, the version management table has been designed to describe these changes in each chapter.

Version	Date		
V 1.0	10/06/2018	Initial version	
V1.1	15/11/2018	Whole document	Textual changes
V1.2	15/03/2019	Chapter 5.	Prequalification
		Chapter 6.	Prequalification tests
V1.3	01/07/2019	Entire document	Textual adjustments
		Chapter 7	Auction: Implementation of marginal pricing and d-2 auctions
V1.4	20-08-2019	Chapter 5	Some textual changes for clarification
V1.5	19-11-2019	Entire document	Textual adjustments
		Chapter 6	Change on overshoot
V2.0	Juli 2020	Entire document	Adjustments in relation to daily auctions with 4 hour blocks
V2.1	Aug 2020	§7.4.4	Adjustment on communication: Mail instead of telephone
V2.2	Oct 2020	§ 4.1.1.3	Time shift from 06h00 to 09h00
		§ 4.1.1	Elaboration on use of allocation message
		§ 4.1.1.1 and §4.1.1.4	Adding Private Network
V2.3	Dec 2020	Entire document	Correction on chapter numbers and cross references
		§ 4.2.2	Added notes on testing allocation message
		§ 6.1.5	Change in test duration of test 'i ' from 8 to 4 hours
V3.0	Mrt 2021	Several paragraphs	Change and additional requirements on FCR based on decision of ACM case number ACM/18/033952
V3.1	June 2021	§ 6.1.5	Several referals corrected
V3.2	Dec 2021	Entire document	Several Adjustments
		§ 3.2.1 a 3.2.4	Adding reserve mode
V3.3	March 2022	Chapter 6	New test scenarios

1. Definitions and Abbreviations

Definition/abbreviation	Description
BSP	In EB-GL: 'balancing service provider' means a market participant with reserve-providing units or reserve-providing groups able to provide balancing services to TSOs;
CPS	Central Postbox System
DSO	Distributed System Operator
EMS	Energy Management System
FCR	Frequency Containment Reserve; FCR
Centralised Frequency Measurement or Centralised FCR Controller	Principle of using a single frequency measurement for activation of a number of decentrally located technical entities forming a FCR providing unit or providing group. The application of this principle requires the respective transmission of the frequency signal to the individual FCR providing unit or FCR providing group
Decentralised Frequency Measurement	Principle of using independent on-site frequency measurements at the connection points or below at site of generating units of the technical entities forming FCR providing units or FCR providing groups and activation of FCR based on this on-site measurement
ITP	Information Transfer Point
RPU	Reserve Providing Unit
RPG	Reserve Providing Group
Special RPG (SRPG)	Is an RPG consisting of a TI of <1.5 MW whereby the data exchange takes place by means of 1 aggregated signal.
RTU	Remote Terminal Unit
EB-GL	Electricity Balancing - Guide Line, Regulation (EU) 2017/2195
SO-GL	System Operation Guide Line; Regulation (EU) 2017/1485
TI	Technical Installation: single power generating module or demand unit
TSO	Transmission System Operator

2. FCR-providing units

This chapter sets out how units/unit groups that intend to provide FCR can be defined and modelled.

2.1 Modelled unit/group configuration

In line with the System Operation GuideLine (SO-GL), TenneT recognises the terms Reserve Providing Unit (RPU) and Reserve Providing Group (RPG). A brief explanation of this is given below.

SO GL Article 3 definitions, paragraphs 2.10 and 2.11
2.10 'reserve providing unit': single electricity-generating unit or combined group of electricity-generating units and/or consumer units linked to a common connection point which provide/provides the required supply of FCR, FRR or RR;

2.11 'reserve providing group: a group of electricity-generating units, consumer units and/or reserve-providing units linked to multiple connection points which provide/provides the required supply of FCR, FRR of RR;

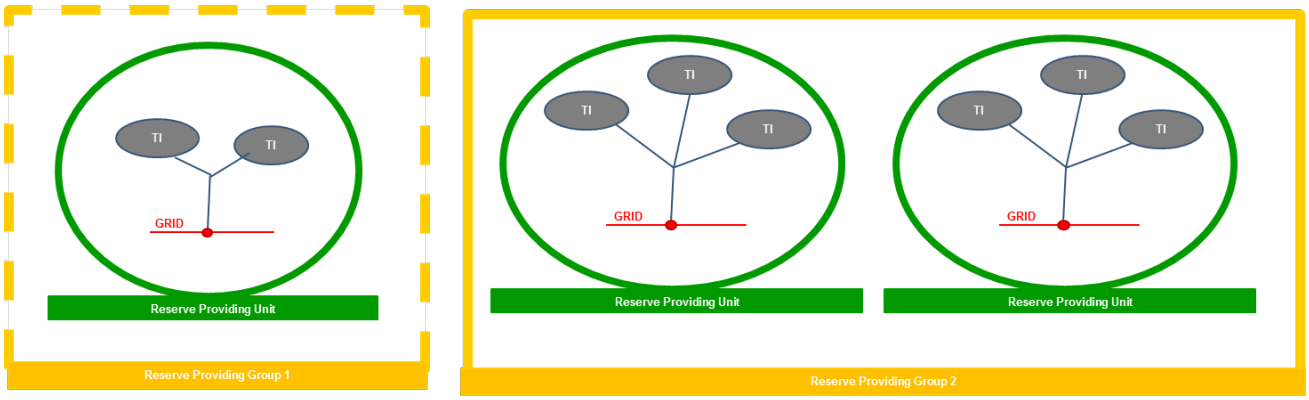


Figure 1, Example of RPU and RPG

The Technical Installations (TIs) behind a single grid connection that collectively meet all requirements of an RPU, in accordance with SO-GL Article 3 definitions, paragraph 2.10 is shown in Figure 1, left. RPUs can also be grouped together in an RPG (Figure 1 right). A group may consist of one or more RPUs.

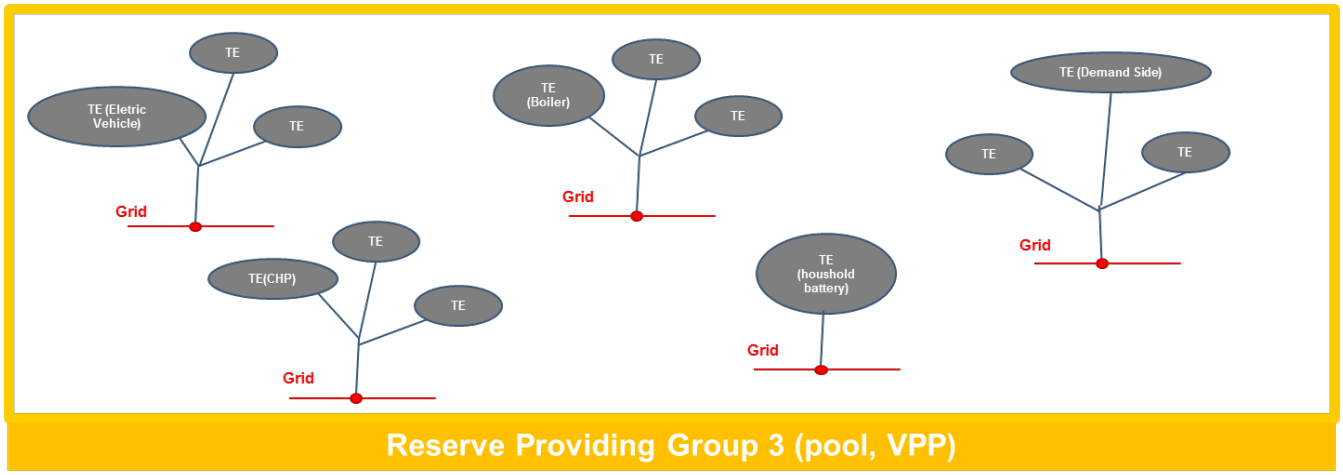


Figure 2, Example of a special Reserve Providing Group, with TIs = Technical Installations

In Figure 2, a special RPG is displayed, which is a defined collection of TIs where although not each individual TI is able to meet the requirements for FCR, the whole RPG can do so. This is in accordance with SO-GL Article 3 definitions, paragraph 2.11.

3. Product specifications and requirements for FCR

3.1 Product-specific requirements and criteria

The prequalification process is made up of different parts, which are described in this manual along with the prequalification test. After prequalification, a framework agreement can be concluded. The framework agreement can be requested via BSP@tennet.eu. If additional power is prequalified and a framework agreement has already been concluded, then only the technical prequalification needs to be carried out without the need of a new framework agreement.
Following prequalification and the signing of the framework agreement, the BSP gains access to the auction platform (Regelleistung). The requirements for participation in the auction and the bids are set out in chapter 7 (Auction) of this manual.

Ensuing from the European Codes (in particular the SO-GL and RfG[2]) and the Dutch System Code, specifications that the FCR product must meet:

- Minimum accuracy of the frequency measurement is10 mHz or industry standard, whichever is better
- Maximum Insensitivity range of the FCR control is 10 mHz.
- Activation speed is 30 s for the full allocated volume
- Frequency deviation for full FCR activation is + 200 mHz / - 200 mHz
- A RPU/RPG must supply FCR for as long as the frequency deviation persists.

[2] FCR requirements which are directly forthcoming out of RfG are not applicable to existing units

- Activation of FCR is not artificially delayed and begins as soon as possible but no later than 2 seconds after a frequency deviation; and rises at least linearly.
  When one of the requirements cannot be met, the FCR providing group or FCR providing unit shall provide technical evidence to TenneT. TenneT assesses these justifications and decides whether or not the unit or group can be qualified to provide FCR.
- Each FCR providing unit or group shall be capable of activating FCR within the frequency range of 47,5 to 51,5 Hz and for time periods of 30 minutes[3]
- FCR providing units and FCR providing groups continue to provide FCR and are not allowed to reduce activation in case of a frequency deviation outside the frequency range of +/- 200 mHz up to the frequency ranges 47,5 to 51,5 Hz.
- If a production units has not been contracted for FCR, the unit in question must maintain a dead band of 500 mHz and a droop of 8% according Gridcode art 14.5 sub 9. What the code wants to achieve is that all units that can still contribute do so in this very exceptional situation, so that load shedding (which starts at 800 mHz) or worse can be avoided.
- For new units[4] the following is applicable according gridcode article 9.27:
  1. Connected entities which have an electricity production unit of type C or D, to which, in accordance with Article 4, first paragraph, of Regulation (EU) 2016/631 (NC RfG) is applicable shall ensure that the provision of frequency response for the active power as referred to in Article 3.24(2) is activated at a frequency threshold of of 49.8 Hz and at a droop of 5%.
  2. Connected entities that have an electricity production unit of type A, B, C or D will have the type A, B, C or D, on which the frequency threshold is activated in accordance with Article 4, first paragraph, of Regulation (EU) 2016/631 (NC RfG) is applicable shall ensure that the provision of frequency response for the active power as referred to in Article 3.13(4) is activated at a frequency threshold value of 50.2 Hz and with a 5% droop.
- A BSP has the right to aggregate the measurement data of units whose power is lower than 1.5 MW, on condition that the maximum power of the combined group of units does not exceed 30 MW and the supply of the primary reserve can be verified.

However, different requirements apply to the supply of FCR for units with limited sources. The requirements for limited sources are described in the next paragraph 3.2).

3.2 Requirements for RPU/RPG's with Limited Energy Leservoirs (LER)

The requirements for supplying the FCR for both limited and unlimited sources are the same apart from some exceptions. For RPUs/RPGs that have an energy limited TI – i.e. batteries - specific requirements apply (based on the SO-GL). These are explained below.

[3] Source: RfG-GL article 13 and SO-GL154 sub 6 (Requirement is not applicable to existing units, also see previous note)
[4] Definition of *new* is stated in RfG-GL article 4

3.2.1 LER specific definitions

Active Energy Reservoir Management	active charging/discharging of the reservoir depending on the state of charge which results from FCR activation to avoid a status of a completely full/empty reservoir;
Effective Energy Reservoir	the energy reservoir of a storage device which can effectively be used for energy feed/absorption;
LER FCR Providing RPU/RPG	FCR supplying RPUs/RPGs are considered LER for FCR if a full continuous activation for a period of two hours in positive or negative direction, without taking into account the effect of an active load management, leads to a limitation of their ability to achieve a full FCR activation, taking into account the Effective Energy Reserve effectively available
Normal mode	Activation of FCR depending on system frequency deviation
Reserve mode	Activation of active power response depending on short term frequency deviation from the mean frequency deviation

3.2.2 15-minute requirement for energy limited sources

RPUs/RPGs that have an energy-limited TI must be in a position to provide constant support to the frequency within the standard frequency range.
If, in the event of a larger frequency deviation, the "alert state"[5] is reached, an installation must be able to continuously supply the full quantity of FCR awarded/contracted for a period of not less than 15 minutes in the event of a deviation of 200 mHz or more, or to supply partial delivery for a proportionately longer period in the event of frequency deviations lower than 200 mHz. Effectively, the supply must take place as soon as the deviation occurs and for at least 15 minutes after the alert state has been reached.
After these 15 minutes (or a proportionately longer period), a limited installation must have the awarded/contracted amount of FCR fully available again as soon as possible, but no later than 2 hours after reaching the standard frequency range.
For the sake of completeness, it should be noted that unlimited sources such as large gas or coal-fired production units must be able to deliver for an unlimited period of time.

3.2.3 Combining energy-limited sources and energy-unlimited sources

Within a RPU/RPG, an FCR-BSP is free to combine energy-limited sources with unlimited installations, in which case the 15-minute requirement (§3.2.2) will relate to the entire RPU/RPG rather than the individual TIs.

[5] In relation to Alert state frequency deviation: |Δf| ≥50 mHz for 15 minutes, |Δf| ≥100 mHz for 5 minutes or instantaneous |Δf| ≥200 mHz

The energy unlimited TI's within RPUs/RPGs do not limit their FCR supply when technical entities with a limited energy reservoir (of that FCR supplying group/unit) are already depleted in positive or negative terms as long as the frequency deviation persists.

In case RPG/RPU with combination of limited and unlimited TI's are not considered as LER if their energy reservoir has the capacity to supply FCR as long as the frequency deviation continues with a duration of 4 hours (the contract period).

3.2.4 Battery

A battery or a pool of batteries has a number of specific characteristics; these include charging limits, self-discharge, ageing, unacceptable operating conditions etc. These must be documented and submitted along with the other prequalification documents. The requirements for this are set as following.

Load management

The frequency within the synchronous system of continental Europe averages 50 Hz.
Periods with average frequency deviations in a single direction will have a continuous effect on the state of charge (SoC) of a battery supplying FCR, despite the fact that the frequency remains normal. As such, active charging management of the batteries is necessary to enable constant frequency support within the standard frequency range". With regard to charging management:

- Load management must be set up in such a way that, when there is a transition from normal to alert state, full activation of the contracted FCR lasting 15 minutes is possible or for proportionally longer when the deviation is less than 200 mHz.
- Charging/discharging for load management of the battery may only occur during "normal state".
- The battery's load management may not be based on operational control that causes a frequency support 'overreaction' whereby more power than necessary is supplied to the grid or drawn to maintain the battery level.
- Load management may not have any impact on the FCR supply.
- The SoC values on which the load management is triggered must be selected in such a way that during active load management a proper monitoring of the delivery is not negatively influenced.
- Load management must be described in the prequalification documents.

Charging and discharging capacity

The charging and/or discharging capacity of the battery is related to the load management and the energy content of the battery. No further requirements are set here (although it must be described in the prequalification report).

Reservemodus

For batteries, it is a requirement to have charge management to be able to continuously activate FCR in normal condition and to fully activate FCR in alert for the time period of 15 minutes. In addition to this requirement, LER has an additional requirement called reserve mode.

The reserve mode requirement does not apply to existing LER RPU's with FCR delivery which are prequalified for the first time before **01-08-2022**. Not even if they undergo a re-prequalification after this date.

The requirement for reserve mode comes into effect for LER FCR installations that have registered for pre-qualification from **01-08-2022**.

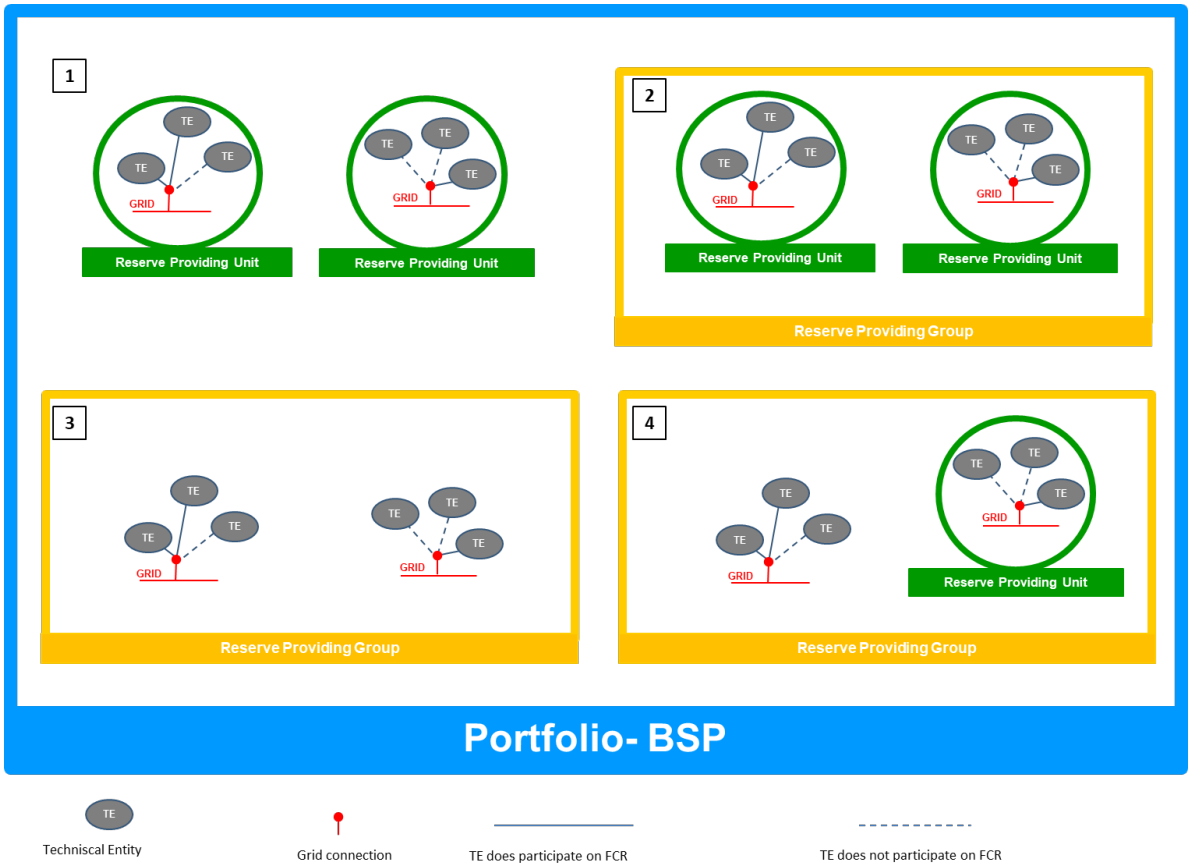
The requirement for a reserve mode reads as follows:

For LER FCR supplying units (individually or belonging to a LER FCR supplying group) that are prequalified for the first time after the methodology comes into force and have technical capability (e.g. inverter connected assets), are able to switch from normal mode to reserve mode.

In terms of content, this means that if the frequency triggers an alert state, charge management stops (as is already the requirement today) and once the SoC reaches specific limits the battery switches from normal mode (response to the actual frequency deviation) to a reserve mode (response to an average frequency deviation).

If an (to be) RPU is not technically capable to switch to reserve mode the BSP must sent in a document which arguments why the unit is not capable. TenneT will decide on the documentation if the unit can proceed in qualification or not.

The Technical Entity's (TE's) behind one connection that jointly meet all the requirements of FCR form an RPU according to SO-GL. The reserve mode applies to LER RPU's. The figure below provides more clarification.



The reserve mode requirement applies to RPUs (green) even if they are part of a group.
Exempted from the reserve mode requirement are those TE's that form a RLG 3 with a defined collection of TE's behind different connections, where not every individual TE can meet all the requirements for FCR but the whole (RPG) can.

A further explanation of the reserve mode is given in annex 8.1. Also additional information can be found in the *explanatory note* published on the TenneT website.

Energy content
The energy content of the battery is related to the power and the load management; No further requirements are set here.

Prequalified power and rated power
ENTSO-E's Policy 1 (Load-Frequency Control and Performance) includes the following:
Limited sources that are used as independent units for FCR supply have a ratio of rated power to prequalified power of at least 1.25:1 or an alternative solution with equivalent effect, for example by active load management.

3.3 Central control

In the case of a central controller and frequency measurement, the FCR-BSP shall ensure that both the control of the TI/RPU and the frequency measurement from the regional 110 kV or 150 kV grid or the underlying grid in which the different TI/RPUs are geographically located are used. This will minimise the effects of a possible system split or communication disruptions to and from the central controller.

The FCR-BSP will therefore ensure that a geographically autonomous activation of FCR in each grid area is possible by setting up a system that detects differences in frequency between regions (of 110 kV and/or 150 kV grids) in the event of a system split or disruption in communication. If the RPU/RPGs include TIs with local frequency measurements, these may be integrated into the above system to detect differences.
The grid areas are defined as follows:

110 kV Groningen/Drenthe/Overijssel
150 kV Gelderland/Flevoland
150 kV North Holland
150 kV Zeeland
150 kV Brabant
150 kV Limburg
150 kV South Holland
110 kV Friesland
150 kV Utrecht

FCR BSP will provide documentation on how autonomous activation per network area is ensured and how differences in frequency measurements are detected.

4. Proces information exchange for FCR

4.1 Exchanging measurement data

Specific equipment is needed for exchanging measurement data and there are various ways of doing so, namely by means of leased lines or a web service. These are explained below followed by a description of the basic principles with regard to the measurement of power.

In accordance with the framework agreement, a BSP is required to store the measurements at TI level for 6 months after delivery.

4.1.1 Power meter

- Measurement of RPU/RPG in MW, to at least three decimal places with a refresh rate between of 4 seconds or shorter, if possible 1 second..
- Maximum inaccuracy must be demonstrably 1% (of the nominal value, class 0.5s).

4.1.1.1 Basic principles

- The location of the Information Exchange Point (IEP).
- The physical point where information is transferred between a BSP and TenneT is at TenneT in Arnhem, the Netherlands, or in one of TenneT's high voltage stations.
- The BSP-FCR is responsible for the data transfer between its own systems and the agreed ITP.
- TenneT is responsible for the data transfer on the route between the IEP and TenneT's systems.
- Each party is responsible for its own share of the costs for the realisation and maintenance of the agreed information exchange. The responsibility for costs is demarcated by the IEP.
- There are three methods of exchanging measurement data: via a leased line and Remote Terminal Unit (RTU), via a web service which uses internet, or via a private mobile network (Also known as M2M).

4.1.1.2 Leased line and RTUs

Detailed specialist consultation will have to take place about the design and implementation of the RTU in order to set out the coordination of the systems used and the specifications of the individual signals unambiguously.

RTUs with the 'IEC 870-5-101' protocol are used for communication with TenneT's Energy Management System (EMS). Given that the 'IEC 870-5-101' protocol is finite, the 'IEC 870-5-104' protocol is currently being prepared for implementation. TenneT has the so-called Protocol Implementation Documents (PID) for these protocols, which can be requested by BSP@tennet.eu .

To limit the risk of interruptions to the signal transmission due to malfunctions or maintenance, a redundant connection - in other words two communication connections - is required. One of these connections acts as a backup, with functionality to switch over automatically if the primary connection is interrupted. Both the BSP and TenneT must be able to switch from the active connection to the backup connection.

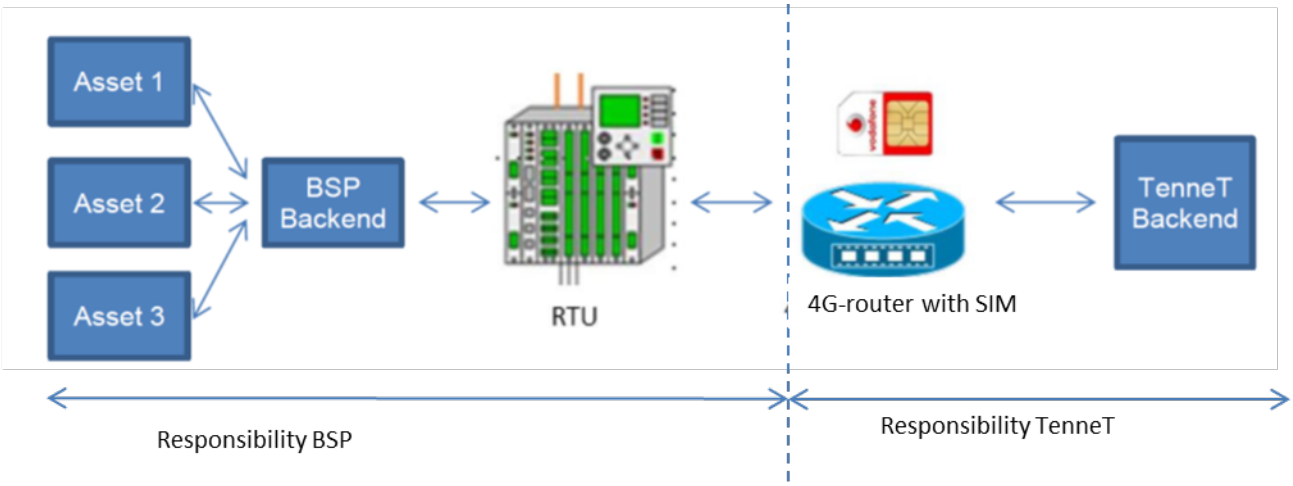
When the 'IEC 870-5-101' protocol is applied, the two connections are scanned simultaneously. In that case, there is one active and one passive connection. The set points are sent via the active connection. The passive connection is scanned by the EMS to check whether the connection is still working correctly.
When the 'IEC 870-5-104' protocol is applied, one connection is called on at the same time. Once a day there is a switch to the other connection on the RTU.

4.1.1.3 Web service

The measurement data can also be submitted to TenneT through an FCR web service. The measurement data can be sent a number of time a day retrospectively, as far as this is done before D+1 09:00. A FCR Webservice Implementation Guide containing a description of how the files are to be arranged has been drawn up. There is also a technical guide that sets out the application procedure for the required certificates, explains which endpoints to communicate with and includes a test file (xml) that can be used to test whether the connection is working. This information can be requested via TenneTCCC@tennet.eu .

4.1.1.4 Private mobile network

When using the private mobile network, TenneT takes care of the infrastructure up to and including the router that is delivered to the BSP.



The location of the information transfer point (ITP) is the physical point where information is transferred between BSP and TenneT and is the router at the BSP. This means the following:

- The BSP ensures that a good reception for the router is possible;
- The RTU has to be able to communicate with the by TenneT accounted IP-adres.
- The BSP is responsible for the connection between the router and his RTU as described in paragraph 4.1.1.1. More information about the implementation of the private mobile network can be requested via tennetccc@tennet.eu.

NB. The change of disruption between TenneT and the ITP is bigger when using the private mobile network compared to the leased line. The webservice has the advantage of sending updated metered data till 09h00 D+1. The BSP has to take these into account when choosing between the different options.

4.2 Allocation messages

BSPs shall allocate the provision of the planned distribution of awarded FCR bids among RPUs and/or RPGs so that TenneT can check the availability and supply of FCR.

4.2.1 Allocation of FCR among RPUs/RPGs

The BSP shall allocate the FCR acquired at the auction among its RPUs/RPGs that are prequalified to supply it. The BSP must inform TenneT about this allocation by means of an electronic message.

In the case of an RPG, the BSP shall act as an aggregator and is responsible for sending a single electronic message detailing the allocation among the TIs within the RPG.

If a BSP is not able to cover the (entire) contracted FCR by its own RPUs/RPGs, the part of the obligation

that cannot be covered may be subcontracted to another BSP. This substitution has to be reported within the allocation message. Subcontracting is only allowed if it concerns symmetrical power and in steps of 100 kW with a minimum of 100 kW.

The FCR-BSP must always transmit the following to TenneT before 5pm on day ahead (D-1):

- the RPU/RPG that will be used the next day for the FCR supply;
- how much FCR per RPU/RPG will be held available;
- any transfer of volume to other BSPs;
- the message only concerns the implementation day (D).

It is not allowed to allocate more FCR over the RPU/RPG's that the commitment to deliver FCR.

If the BSP needs to switch RPU/RPG during the day, the BSP's central contact point shall inform TenneT of this without delay by means of a new allocation message
The BSP shall send the allocation message to the Central Postbox System (CPS) which is the closed system TenneT uses to exchange messages with business partners. A connection to the CPS is therefore a precondition for BSPs to participate in the FCR auction. More information on this can be requested by sending an email to tennetccc@tennet.eu

The allocation message is delivered in a standard ENTSO-E format ERRP 5.0 – PRS (ENTSO-E Reserve Resource Process - Planned Resource Schedule). The message specifies how much FCR each RPU or RPG is withholding during which period. The RPU/RPG's droop is also stated and it is possible to specify that the supply of an amount of FCR during a particular period is being outsourced to another prequalified BSP.

The message specifications and the communication process are described in the FCR allocation message document that can be found on the TenneT website[6]. An excel converter is made available for composing the allocation message. This can be found on the TenneT website[7].

It is very important to be aware that the allocation message is one of the fundaments for monitoring. So if there is no allocation message this will generally lead to No-Availability.
If the BSP is not able to send an allocation message via the normal procedure, due to a connection problem or system failure at TenneT, the allocation message can be sent via e-mail to ProcesspecialistenSON-SYBalanshandhaving@tennet.eu and tennet-operational-planning@tennet.eu

If, when sending a new or updating an existing allocation message, a Nack Message is received, the BSP is responsible to correct the allocation message according to the rules and specification described in the document 'FCR allocation message' to be found on the TenneT website. If a Nack Message is sent by TenneT, any allocation message received via e-mail will generally not be accepted.

[6] https://www.tennet.eu/electricity-market/ancillary-services/fcr-documents/
[7] https://www.tennet.eu/electricity-market/ancillary-services/fcr-documents/

As a general remark, the FCR delivery should not be jeopardize by the impossibility to send an allocation message to TenneT.

4.2.2 Testing allocation message during prequalification

It is possible to test the creation of the allocation message and check if it is correctly processed in TenneT system. To do so, the allocation message should be sent via e-mail (not via the CPS-connection) to TenneT. In order to facilitate this testing, two test scenarios have been defined and are described in the document '*FCR Allocation Message test scenarios'* which can be found on the website of TenneT[4]
When these allocation messages have been correctly processed by the TenneT system, a positive acknowledgment will be sent to the BSP.

5. Prequalification

5.1 Prequalification procedure

BSPs use the prequalification procedure to prove in advance that they and their RPU/RPGs fulfil the requirements relating to the supply of FCR. To that aim, BSPs must submit a prequalification application for each TI or group of TIs.

The prequalification procedure is described in more detail in "Prekwalificatieproces voor FCR, aFRR, mFRRsa, mFRRda en ROD". This information can be found on the TenneT website.

5.1.1 Applying for prequalification process

The prequalification process starts with filling in an application form. All technical installations that are part of the prequalification test should be indicated in this application. In case the TI(s) are connected to the connecting DSO grid, a DSO is entitled (during the prequalification procedure, in accordance with SO-GL Article 182 paragraphs 4 and 5), in consultation with TenneT, to set limits on the supply of FCR in its distribution grid or to exclude the supply of FCR in its distribution grid for technical reasons, such as the geographical locations of the RPU or RPGs.

The application has to be send one month in advance because TenneT has to align the prequalification test with the concerning DSO.

5.1.2 Prequalification test

Chapter 6 describes the prequalification tests . The prequalification test shall be carried out by the BSP himself, and has to be done under the supervision of qualified operators. If TenneT wishes, TenneT has to be permitted to be present while the actual tests are being carried out.

5.1.3 Evaluation of prequalification

5.1.3.1 Check for completeness

For the purpose of the prequalification of the BSP and its operational resources, a first check of the completeness of the data submitted is done. TenneT will notify the BSP no later than 8 weeks after receipt, in accordance with SO-GL Article 155, paragraph 4. If the application for prequalification is incomplete, TenneT will inform the BSP of this, stating the matters that are missing in the application. This also applies in case of non-compliancy with the regulations.
In case TenneT considers that the application is incomplete, additional required information shall be submitted within 4 weeks from receipt of the request for additional information. If the potential BSP-FCR does not supply the requested information within that deadline, the application shall be deemed withdrawn.

5.1.3.2 Substantive assessment of the Technical Installation

TenneT evaluates the application for prequalification by establishing whether the minimum requirements specified in this manual have been fulfilled. Not fulfilling the minimum requirements will result in the application for prequalification being declined.

5.1.3.3 Submission of allocation messages and measurement values

In order to be prequalified (for the first time), the BSP or a party assigned by the BSP must be in a position to submit allocation messages via the CPS in accordance with §4.2 and the 'FCR allocation message' document. The BSP must also be able to submit measurement data in accordance with §4.1.

Within 3 months from confirmation that the application is complete, TenneT will evaluate the information provided, in accordance with SO-GL Article 155 paragraph 4, and decide whether the RPG/RPU meet the criteria for an FCR prequalification.

5.1.4 Prequalification Status

Once the prequalification procedure has been completed, TenneT will inform the BSP of the result of the prequalification. When the prequalification has been awarded, the BSP is entitled to participate in the tendering procedure on the auction platform (Regelleistung.net). For this the framework agreement between TenneT and the BSP then needs to be concluded. If a TI or group of TIs has/have already been prequalified as RPU/RPG and a framework agreement has already been entered into, then the relevant prequalified RPU/RPG will be added to the existing framework agreement.

5.1.5 Termination/withdrawal of the prequalification

TenneT is entitled to terminate a prequalification at any time if:

- in providing TenneT with information during the procedure for prequalification, the prequalified BSP is found to be guilty of making false statements and/or submitting incorrect information;
- after prior notice of default in which he/she the BSP was given a reasonable period for remedy, the prequalified BSP no longer fulfils the minimum requirements as specified in these regulations;

- the above can no longer be verified.

Should the occasion arise, TenneT will inform the BSP in question of its intention to terminate the prequalification and of the reason for this, in writing.

5.2 Volume to be prequalified

5.2.1 Volume for prequalification at initial recognition of an FCR-BSP.

At the (first) application for recognition as a FCR-BSP a minimum of 1MW must be offered for prequalification.

TenneT allows an individual unit (RPU), or a group of units (RPG), to prequalify with a minimum of 1 MW of rated power - with a step size of 0.10 MW. Volumes of 1.10 MW, 1.20 MW, 1.30 MW, etc. are therefore allowed.

A RPU and/or TI with a prequalified power of less than 1 MW shall form a RPG (pool) with at least one other RPG and/or TI. An RPG (pool) must at all times consist of at least RPUs or TIs with a minimum total of 1 MW of prequalified power.

The creation of an RPG is always in consultation with TenneT. TenneT is entitled to set out requirements on RPG's (For instance no combinations of installations with very large differences in nominal power).

In addition: When the total prequalified power is for example 1.3 MW and the awarded power in auction is 1 MW and so could be delivered with multiple RPU's. It is up to the BSP to distribute the 1 MW over his RPU's with a resolution of 0.10 MW.

5.2.2 Additional volume for prequalification.

The minimum additional power to be prequalified in an RPU/RPG (after initial prequalification of at least 1 MW RPG) is 0.10 MW or multiples of this.
After approval of the TSO, the unit or units can be added to the RPG or act as a a single RPU. The risk of this addition to an existing RPG (e.g. disrupting the other units in the RPG) shall lie at the BSP.

The creation of an RPG is always in consultation with TenneT. TenneT is entitled to set out requirements on RPG's (For instance no combinations of installations with very large differences in nominal power.

In addition: offering the extra power at the auction remains the same, i.e. with a step size of 1 MW. However, the BSP does have the choice of using the required installation(s) for a bid from its entire prequalified volume. The resolution for allocation messages is therefore 0.10 MW.

5.3 Special RPG (SRPG)

An RPG may comprise no more than 150 MW of prequalified power. In the case of an RPG, the FCR-BSP shall provide an aggregated measurement signal for the whole RPG, allowing clear verification of FCR activation. The allocation of an RPG is made at RPG level.

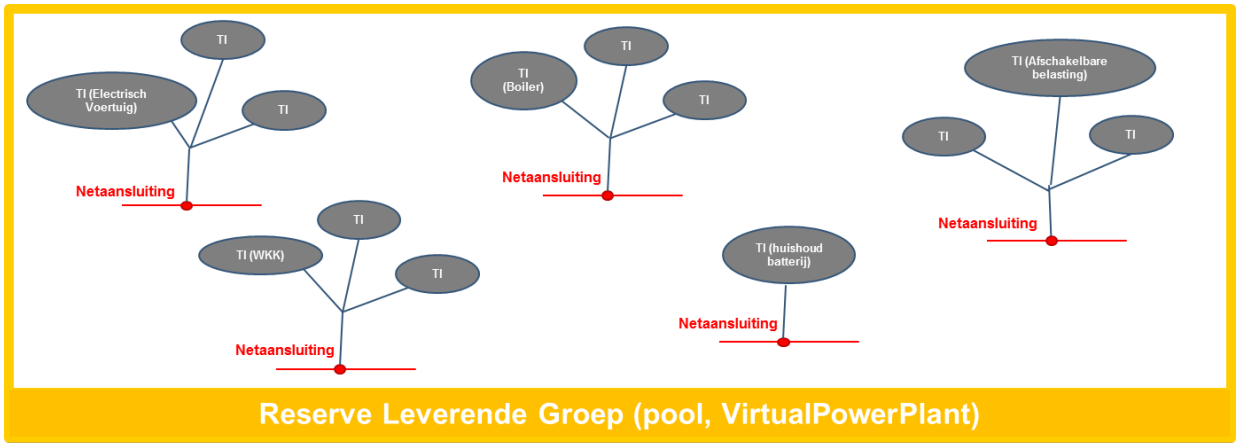


Figure 3, Special Reserve Providing Group

In Figure 3 the RPG is a defined collection of TIs where although not each individual TI is able to meet the requirements for FCR, the whole RPG can do so.

Allowing an RPG for FCR supply will also entail a data aggregation test. Data from both individual FCR-providing units and from the whole pool shall be submitted for the purpose of checking the prequalification.

5.3.1 Type approval in a special RPG

TIs of the same type with a rated power of less than 1.5 MW and which can be shown to have the same control behaviour as TIs that have already been prequalified do not need to undergo an individual prequalification test. These TIs can be added to an RPG after TenneT's approval on the basis of information supplied showing that the control behaviour is complementary to the control of the entire RPG.
TenneT reserves the right to decline the technical installation or to demand an additional prequalification test.

The risk of any negative effects on supply as a result of added type-approved TIs, even after TenneT's approval, remains with the BSP.
If a TI's prequalification test is carried out within an RPG, whereby the RPG participates in FCR supply with the volume awarded at auction, the risk of negative effects on the (regular) delivery remains with the BSP.

5.3.2 Modifications within a special RPG

FCR-providing units can be added to an RPG in steps of 0.10 MW after an approved prequalification of the TI in question.

In the case of the merger/division of already prequalified RPGs (pools) into a new RPG (pool), TenneT may require the new RPGs to undergo a new prequalification test.

5.4 Repetition of prequalification

The prequalification will have to be repeated in the following situation:

- After 5 years at the latest, the FCR-BSP shall be reassessed by means of a prequalification test, whereby TenneT can demand a new test (SO GL Art 155 paragraph 6). In the case of an RPG (as in §5.3), the whole RPG will need to be prequalified again;
- If the technical specifications, availability specifications or specifications of the FCR equipment have been changed;
- In the event of modernisation of the equipment used for FCR activation.

Any modifications in RPU/RPG that will impact the FCR supply must be discussed with TenneT. Additional agreements could be made according to the numbers and volumes of varying TIs.

5.5 Flowchart showing prequalification types

The figure below shows how TenneT categorises the technical prequalification.

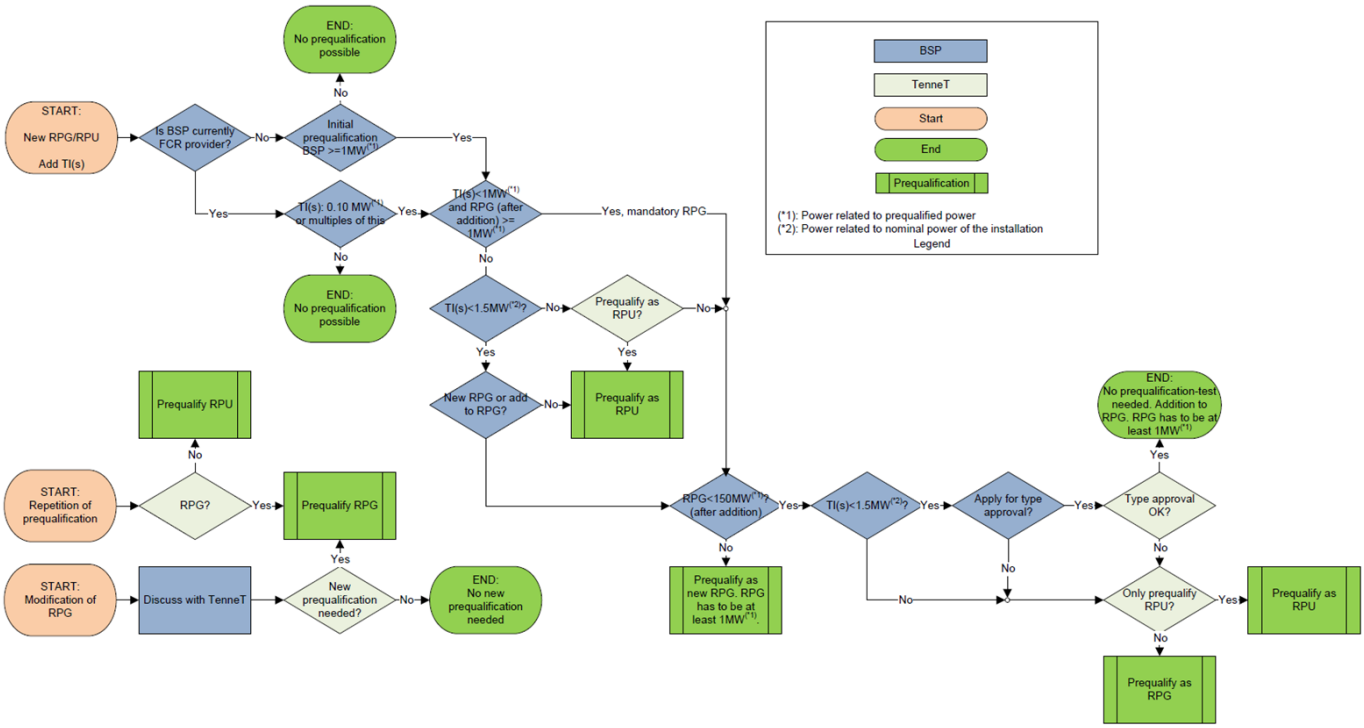


Figure 4 Flowchart showing prequalification types

6. Prequalification tests

6.1 Test protocol

6.1.1 Introduction

In order to prequalify for the supply of FCR, the RPU/RPG's technical requirements must be tested as described below. The installation settings and the corresponding controls (e.g. droop) must be set as they would be in normal operation. Changing settings in order to pass (specific) tests is not permitted. During the prequalification test, stepwise and uniform frequency deviations from the nominal frequency will be simulated.

6.1.2 Explanation of droop

It should be noted that a certain percentage of the rated power that is to be prequalified corresponds with a certain droop.
The droop settings depend on the amount of power to be prequalified and can be calculated by using:

$$x = \frac{-\Delta f / f_{nom}}{\Delta P / P_{nom}} \cdot 100\%$$

Where:

Δf = frequency deviation in Hz (defined as $\Delta f = f - f_{nom}$)
f_{nom} = nominal frequency (= 50 Hz)
ΔP = difference in capacity for the purpose of FCR in MW
P_{nom} = nominal power in MW
x = droop in %

The full FCR volume must be activated if the (quasi-stationary) frequency deviation is ± 200 mHz. Together with P_{nom} and the offered bid size, this forms the basis for calculating the droop for the unit concerned. The table below gives an example of this with 500 MW as nominal power and 20 MW as FCR capacity:

Description	Value
Δf =	0.2 Hz
f_{nom} =	50 Hz
ΔP =	20 MW
P_{nom} =	500 MW
x =	$x = \frac{-\Delta f / f_{nom}}{\Delta P / P_{nom}} \cdot 100\%$ $x = \frac{0.2/50}{20/500} \cdot 100\%$ $x = 10\%$

The sample data used in the above table includes a power change in relation to frequency as shown in Figure 4

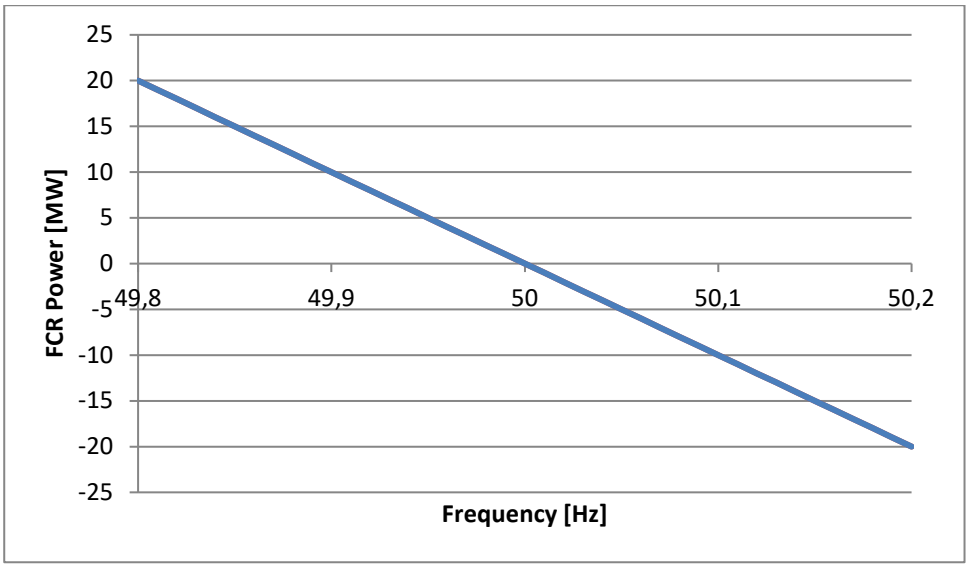


Figure 4, Droop corresponding with the above example

Please note: Energy limited sources that (when disregarding load management) at a grid frequency of 50.000Hz do not have any power exchange with the grid, may specify 0% as droop.

6.1.3 Explanation of insensitivity range

The maximum combined effect of inherent frequency response insensitivity and possible intentional frequency response dead band of the governor of the FCR providing units or FCR providing groups is 10mHz, according to Annex V of SO-GL

Unlike a dead band, applying an insensitivity range means that a response (set point to a unit) from the controller is required when the threshold value at the controller input value is exceeded. On no condition may the insensitivity lead to reduced response, which means that at 200 mHz frequency deviation, there must be a full response.

An insensitivity range of 10 mHz *around the operating point* is allowed so the FCR control is more stable. This means that a frequency change of 9 mHz relative to the current operating point (set point of the FCR controller) does not have to result in a power change; however, a change of 10 mHz or more must result in a power change for the full value corresponding to the set droop. Graphically, this can be shown as follows (Figure 5):

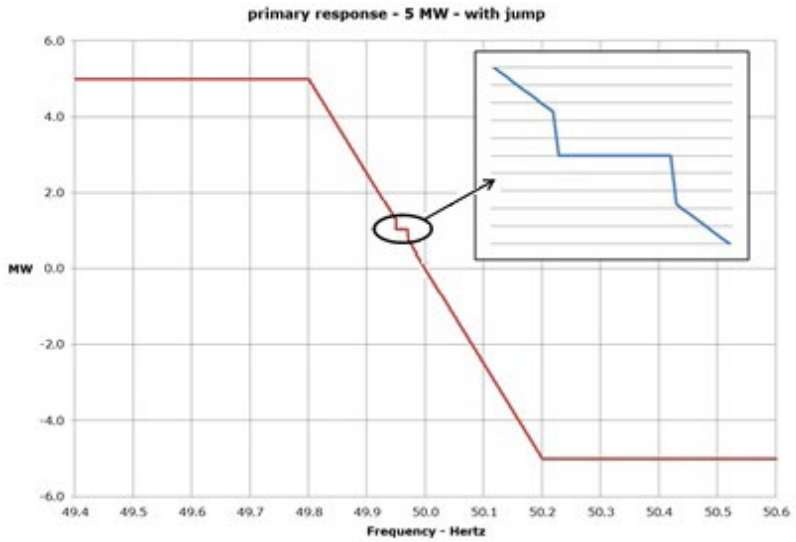


Figure 5, Example of insensitivity

In addition: A dead band is therefore an insensitivity range *around a specific value*, while an insensitivity range can be *around any value*[8].

6.1.4 Requirements

The following requirements are also set out in §4.1.1, but for the sake of completeness they are included again here:

- Accuracy of the power measurement: margin of error <1% (of the nominal value, class 0.5s).
- Accuracy of the desired frequency measurement: <10 mHz.
- Measuring interval: test a-f resolution of 1 second. Test g: resolution of 1 to 4 seconds is acceptable.

The different measurements must have an unambiguous time stamp and be time-synchronous.

A. The following requirements apply to all tests, and are to be considered valid during normal operation:
   1) The power change shall not be artificially delayed and shall start as soon as possible after a frequency deviation[9].
   2) Overshoot is not desirable. When overshoot (in either direction) occurs the BSP is obliged to give an clarification on that matter.
   3) The power change, corresponding to the simulated frequency deviation, must be supplied during the set period (as specified in the test descriptions below).

B. The following requirements apply to the responses to stepwise frequency changes (tests a to f):
   1) At least 50% of the power change corresponding with the simulated frequency change must be

[8] Also see COMMISSION REGULATION (EU) 2016/631 of 14 April 2016) network code on requirements for grid connection of generators (GL-RFG) Art 2;
39. 'dead band of the frequency response': the intentionally introduced interval within which the frequency control does not respond;
40. 'frequency response immunity': the inherent characteristic of the control system, specified as the minimum size of the change in frequency or input signal that results in a change in output power or output signal;

[9] If the delay lasts longer than two seconds, the owner of the electricity production plant shall justify the delay and provide TenneT with a technical statement [rewritten from RfG code, Article 13, paragraph 2.e.].

supplied within 15 seconds from the beginning of each frequency step.

2) The power change corresponding with the simulated frequency change must be supplied within 30 seconds from the beginning of each frequency step.
3) The power change should behave at least linearly between 15 and 30 seconds after each frequency step.

6.1.5 Description of tests to be performed

The tests shall be conducted by qualified technicians under the responsibility of the BSP. The measurement results are the basis of the prequalification. The RPU/RPG must remain connected to the grid during the tests.
The tests to be performed assess the power to be prequalified; the droop (sensitivity) is set such that the expected power changes are realised.
BSP shall perform the tests described below, where 'power' means the power that is to be prequalified. After consultation with TenneT a BSP can deviate from the following order.

It should be noted that in case of energy-limited units (for instance batteries), a State of Charge (SoC) can be agreed instead of a power set point from which the tests are conducted. In such a case, the agreed State of Charge shall be used as the starting point for each partial test.
If applicable, charge management and thus also reserve mode if applicable, must be switched on during the whole duration of the test, in accordance with the Alert State triggers.

Besides frequency and power, energy-limited units should also include the State of Charge as a measurement value: During the tests a) to e), the power achieved after reaching the set point corresponding to the simulated frequency deviation must be supplied for at least 15 minutes. The counting of these 15 minutes starts from when the power reaches the setpoint and stops when the new setpoint is given.

If the prequalification involves FCR-providing units that are only going to supply FCR in one direction, then the following applies:

- Where power only provides support in the event of frequency reductions (frequency deviation <0 mHz), tests a) and d), are omitted. Tests c) and f) may be executed only in the applicable direction.
- Where power only provides support in the event of frequency increases (frequency deviation >0 mHz), tests b) and e) are omitted. Tests c) and f) may be executed only in the applicable direction.

a) At a power setting between minimum net power and maximum net power, established in consultation with TenneT, the full power reduction must be achieved within 30 seconds at a simulated frequency step of +200 mHz. The power change shall be then maintained for at least 15 minutes, after which a simulated frequency step shall be made to 0 mHz deviation (in relation to the nominal frequency). After the simulated frequency step to 0 mHz deviation is finalised, the next test can be started; thus no need to wait for 15 minutes in between the tests. For each of the two frequency steps, the power change must meet the requirements set out in section 6.1.4, paragraph A and paragraph B.

b) At the power setting stated under a), the full power increase must be achieved within 30 seconds at a

simulated frequency step of -200 mHz. The power change shall be maintained for at least 15 minutes, after which a simulated frequency step shall be made to 0 mHz deviation (in relation to the nominal frequency). For each of the two frequency steps, the power change must meet the requirements set out in section 6.1.4, paragraph A and paragraph B.

c) At the power setting stated under a), half of the power reduction must be realised in 30 seconds at a simulated frequency step of +100 mHz. The power change must be maintained for at least 15 minutes, after which a simulated frequency step shall be made to -100 mHz deviation (in relation to the nominal frequency). The power change must be maintained for at least 15 minutes, after which a simulated frequency step shall be made to 0 mHz (in relation to the nominal frequency). For each of the three frequency steps, the power change must meet the requirements set out in section 6.1.4, paragraph A and paragraph B.

d) At the power setting stated under a) the frequency steps enlisted below must be simulated successively. For each frequency step, the power change must meet the requirements set out in section 6.1.4, paragraph A and paragraph B.
   - Frequency deviation = 0, at the beginning of the test.
   - Frequency step shall be made to +99.99 mHz deviation (in relation to the nominal frequency), the corresponding power change must be maintained for at least 15 minutes[10].
   - Frequency step shall be made to +200 mHz deviation (in relation to the nominal frequency), the corresponding power change shall be maintained for at least 15 minutes.
   - Frequency step shall be made to 0 mHz deviation (in relation to the nominal frequency).

e) At the power setting stated under a) the following frequency steps must be simulated successively. For each frequency step, the power change must meet the requirements set out in section 6.1.4, paragraph A and paragraph B.
   - Frequency deviation = 0, at the beginning of the test.
   - Frequency step shall be made to -99.99 mHz deviation (in relation to the nominal frequency), the corresponding power change shall be maintained for at least 15 minutes[6].
   - Frequency step shall be made to -200 mHz deviation (in relation to the nominal frequency), the corresponding power change shall be maintained for at least 15 minutes.
   - Frequency step shall be made to 0 mHz deviation (in relation to the nominal frequency).

f) At the power setting stated under a), a steady power decrease of the full power must be realised in 2 minutes at a simulated steadily increasing frequency deviation of 0 mHz to +200 mHz. After the power set point due to the power change has been reached (corresponding to a frequency deviation of +200 mHz) and the supply is stable (thus the power change is not necessary maintained for 15 minutes), then the simulated frequency deviation will steadily go to -200 mHz in 4 minutes. Once the supply is stable again, the frequency deviation will steadily return to 0 mHz in 2 minutes. For each of the three changes

[10] In relation to Alert state frequency deviation: $|\Delta f| \geq 50$ mHz for 15 minutes, $|\Delta f| \geq 100$ mHz for 5 minutes or instantaneous $|\Delta f| \geq 200$ mHz .

in simulated frequency, the power change must meet the requirements set out in section 6.1.4, paragraph A. The power changes must be linear and be fully achieved within 2.5, 4.5 and 2.5 minutes respectively (max 30-second lag in simulated frequency response[11]).

g) Once the above tests have been completed satisfactorily, the RPU/RPG shall follow the frequency for 4 hours under normal operational conditions with the full FCR volume.

6.1.6 Reporting and evaluation

In order to fulfil the prequalification requirement, the BSP must provide the results of the tests as an annex, including at least:

- A description of the volume to be prequalified;
- Measurement protocol including the relevant measurement results;
- Test structure, precise specification of the measuring points;
- Test time, list of tests performed;
- Description of the way the tests have been done and at which relevant settings;
- The original time-synchronous measuring data including at least:
    - Date and time;
    - Actual or simulated frequency;
    - Power measurement;
    - State of Charge, if applicable.
- If applicable, a description of the charging management (this is also part of the required prequalification documentation) and if applicable the description of the reserve mode;
- Persons involved in the test (including the contact for the test).

The results will be checked by TenneT or by an independent third party appointed by TenneT.

6.1.7 Sample report

A sample report for information about the expected layout of the test result report must be used and can be found on TenneT's website.[12]

[11] The power changes must be fully achieved within 2.5, 4.5, 2.5 minutes respectively, with a maximum allowed delay of 30 seconds. Therefore, the "lag of max. 30 seconds" is intended in the reaching of the desired set point as a response to the simulated frequency

[12] https://www.tennet.eu/electricity-market/ancillary-services/fcr-documents/

7. Auction scheme

7.1 General

- The BSP has entered into a framework agreement with TenneT which shall remain in force at least until the end of the auction period.
- Upon the contract being awarded, the BSP shall remain continually available during the entire reservation or supply period, without intervention or action on the part of TenneT.
- Reimbursement is based on marginal pricing and depends on the highest awarded bid in the Netherlands when and if this is higher than the CrossBorder Marginal prive; or Croos Border Marginal price if this is higher than the highest awarded priceof a Dutch bid. More information about Cross Border Marginal Pricing is to be found in the description document of the platform algorithm which is to be found on the TenneT website.
- Energy costs, possible imbalance costs, network use charges etc shall be borne by the BSP.

7.2 Definitions

Prequalified power:	the power that fulfils all requirements to participate in the auction for FCR, as specified in this manual and the framework agreement.
Auction period:	the entire period for which the FCR auction concerned is being held. The auction period is 4 hours
Bid period:	the entire period in which the BSP can submit a bid for making available and supplying FCR for the corresponding auction period Gate opening time is D-14
Award:	TenneT's notification by which the supply contract is concluded
Award period:	the entire period from closure of the bid period to award. D-1 between 8:00 – 8:30.
Closing date:	the end of the bid period. The closing date and award takes place at d-1(also in weekends and holliday's) at 08:00

GCT 8:00 (CET)	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Delivery (D)	Tuesday	Wednesday	Thursday	Friday	Saterday	Sunday	Monday

7.3 Bids

7.3.1 Bid

1 The bid shall include the following data:

- Name of the BSP
- Period to which the bid applies (dd.mm.yyyy)
- Area where actual delivery takes place (Netherlands; 10YNL----------L)
- EIC code of the BSP

- Product name ((NEGPOS_00_24))
- The FCR being offered is symmetrical (3 MW = 3 MW up and 3 MW down) and in whole MW values with a minimum of 1 MW
- Remark bids as divisible or indivisible. Indivisible bids are at maximum 25MW
- The price in €/MW

2 The bid must satisfy the following conditions:
- The bid shall contain all elements stated under the previous point and shall be unambiguous and without reservation.
- The bid shall be submitted on the internet platform before the closing date.
- The bid for volume shall relate to the entire period for which the FCR auction is being held (auction period)
- The bid (in this case the price or availability price) shall apply to the full period for which the FCR auction concerned is being held

3 The BSP is responsible for the correctness and accuracy of its bids. Any errors or mistakes made shall be borne entirely by the BSP. Any incomplete or unclear bids will be regarded as not having been submitted.

4 The BSP may bid up to the total of its individual prequalified power.

5 When bidding, the BSP must take all limiting circumstances (for example in its production units or possible congestion) into consideration with the volume to be bid.

7.3.2 Bids via the internet platform

1 Bids must be submitted via the 'regelleistung.net' internet platform. Before the BSP can bid, a 'bidder environment' must be set up. The corresponding access rights will be supplied by TenneT after the BSP has signed the framework agreement and accepted the corresponding Appendices.

2 Details about the format, content and method of submitting bids and awarding the contract as also documents about the Web-API for bids are available in the 'bidder environment'. TenneT reserves the right to change the format and/or method of bidding. If such changes are made, the BSP will be informed well in advance of their implementation date.

3 The BSP has until the end of the bid period to submit bids.

4 The BSP may change its bid up to the end of the closing date. Submitting a new bid will overwrite the previous bid and a new time stamp will be given. This means the previous bid will lose its validity.

5 All bids will apply independently of each other.

7.3.3 Legal aspects relating to electronic bids

1 The parties acknowledge that the electronic bids submitted and award decisions are considered to be legally binding even without a handwritten signature, without an electronic signature and/or encryption, insofar as relevant legislation allows this.

2 The BSP shall remain responsible for its documentation and retention obligation. The internet platform does not provide any documentation or archiving capability.

7.3.4 Breakdown in data connections and/or internet platform

1 In the event of the internet platform being unavailable or if there are other serious system restrictions, then after consultation with other participating TSOs, TenneT will be entitled to suspend the current auction and, if possible, repeat it at a later date. In such a case, TenneT will make an announcement no later than at the end of the regular award period. In this case § 7.4.4 is applicable.

2 If only the connection between the BSP and the internet platform is disrupted and after prior telephone consultation with TenneT[13], the BSP will be given the opportunity of sending TenneT a complete bid in the specified electronic XML file by email[14]. The BSP shall remain responsible for its bids in this form of tendering and shall be bound by all ensuing rights and obligations. In particular, the BSP shall remain responsible for submitting its bid in time, for the completeness of the information, the formal correctness of its bids and the electronic legibility of the XML file.

3 In the event of disruptions to the internet platform or individual connections, the results shall only be announced after the usual award period. In the event of a delay, the BSP will be informed as soon as possible. If there are significant delays, TenneT reserves the right, in consultation with other participating TSOs, to cancel the tendering procedure and repeat it at a later date. TenneT is not obliged to provide compensation for any losses resulting from such delays.

7.4 Awarding

7.4.1 Award decision

The award shall take place on the basis of the bids, which are valid pursuant to § 7.3.1, from the relevant auction and after evaluation of the award criteria pursuant to § 7.4.2 The decision to award the FCR is non-discriminatory. The award shall be made separately for each tender in accordance with the published deadlines.

7.4.2 Award criteria

The purpose of the award is to acquire FCR at the lowest possible price/collective price.

1 The awarding of the bids is carried out in the tendering process on the basis of the following criteria:
- Lowest price performance.
- In the event of equal prices: oldest entry time stamp.

2 The following conditions shall apply in the event of the contract being awarded:
- If a bid is divisible FCR may be partially awarded. The then partially contracted FCR shall be at least equal to the minimum bid size and no greater than the power offered in the bid. It is payable in whole steps of 1 MW. The price of the bid shall remain unchanged.

3 In consultation with the other participating TSOs, TenneT reserves the right:
- To adjust the award criteria to changes or regulatory amendments. TenneT shall inform the BSPs of any changes without delay. The BSP's permission is not required.

[13] TenneT backoffice Lehrte in Germany
[14] Via backoffice-d@tennet.eu

- In consultation with the regulator, bids whose prices distort the market may be excluded. The exclusion criteria given by the regulator in that case will be published.

7.4.3 Announcement of award and establishment of supply contract

1 In principle, the internet platform is used for the notification of the award. The result can be seen on the platform at the end of the award period. There will be no supplementary written notification. After the end of the Award period, the BSP shall therefore be obliged to find out about the result on the internet platform.

2 If the notification of award is not possible via the internet platform for technical reasons, then an email will be sent to the contact on the contact list in the framework agreement.

3 With the award, a supply contract between the BSP and TenneT is concluded for the reservation and supply of FCR for the duration of the auction period and under the conditions of the framework agreement.

4 BSP's can transfer the obligation, on terms that transfer must take place symmetrical, in steps of 100kW and with a minimum of 100 kW

7.4.4 Delay in award

If at the end of the award period an electronic announcement of the award is not possible for technical reasons, then an email will be sent from the Regelleistung platform to all bidders. The used mail addresses are subtracted from annex 2 'contacts' of the framework agreement[15]. It is of great importance the contact list is maintained up te date by the BSP. And when updated sent to TenneT.
In these exceptional cases, the bids will remain valid until a deadline is communicated by email.

8. Bijlagen

8.1 Bijlage Normal versus Reserve Mode

Definitions

Normal mode:	Activation of FCR depending on system frequency deviation
Reserve mode:	Activation of active power response depending on short term frequency deviation from the mean frequency deviation
Alert state:	$\|\Delta f\| \geq 50$ mHz during 15 minutes, $\|\Delta f\| \geq 100$ mHz during 5 minutes of $\|\Delta f\| \geq 200$ mHz instantaneous
T_{FAT}:	Full Activation Time aFRR; 5 minutes[16]

[15] The mail adresses mentioned at subject "Aanspreekpunt veiling primaire reserve" in the contact lists are used. It is possible to add multiple contacts on that subject to have backup in case of absence of the first contact.
[16] T_{FAT} aFRR will change (expected July 2022) from 15 to 5 minutes

Normal mode versus reserve mode

LER FCR supplying units (individually or belonging to a LER FCR supplying group) that have technical capability (especially inverter-connected assets) are able[17] to switch from normal mode to reserve mode when the upper (soc_{max}) or lower (soc_{min}) limits of the SoC are exceeded. These limits are defined as the amount of energy needed to supply FCR during a time interval equal to the full activation time of aFRR being 5 min:

- $$soc_{min} = \frac{P * \Delta t_{FAT}}{C}$$

  $$soc_{max} = 1 - soc_{min}$$

  Where:
  - C is storage capacity in MWh
  - P is the FCR offered capacity in MW
  - Δt_{FAT} is the aFRR full activation time in hours (0,0833….. hour, $\frac{1}{12}$ hour).

- When the SoC is restored, the unit returns to normal mode.
  In normal mode the unit responds to the normal frequency deviation $\Delta f_{(t)}$, whereas in reserve mode the unit responds to the short term frequency deviation only by following the average frequency:

$$\overline{\Delta f_{zero-mean}(t)} = \Delta f(t) - \frac{1}{n(t-\Delta t_{FAT})} \sum_{i=0}^{n(t-\Delta t_{FAT})} \Delta f$$

- During the transition period from normal mode to reserve mode and vice versa, the unit responds to the combination $f_{reaction(t)}$ of normal frequency deviation and short-term frequency deviation, as described by the following equation:

$$f_{reaction}(t) = \overline{\Delta f_{zero-mean}(t)} \cdot T + (1-T) \cdot \Delta f(t)$$

  Where:
  - T is defined as a weighted function.

- For transition from normal mode to reserve mode:

$$T = \begin{cases} 0 & t < t_{start} \\ \frac{t - t_{start}}{\Delta t_{FAT}} & for\ t_{start} \leq t < t_{start} + \Delta t_{FAT} \\ 1 & t \geq t_{start} + \Delta t_{FAT} \end{cases}$$

[17] If the installation is technically not able to implement this, a technical argumentation must be provided

Where:

- t_{start} is the time when the upper or lower SoC are exceeded.

- For the transition from reserve mode to normal mode:

$$T = \begin{cases} 1 & t < t_{restore} \\ \frac{t_{restore} - t}{\Delta t_{FAT}} + 1 & for\ t_{restore} \leq t < t_{restore} + \Delta t_{FAT} \\ 0 & t \geq t_{restore} + \Delta t_{FAT} \end{cases}$$

Where:

- $t_{restore}$ the time after which the upper or lower SoC value is no longer exceeded .

The insensitivity range must be observed in both normal and reserve mode (the full frequency range is used as the input signal, but the FCR delivery is limited to momentary frequency deviations in reserve mode).