Version 1.1.2

ENERGINET

Energinet

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IMPLEMENTATION GUIDE - AFRR EAM

Forfatter:

MYE/TSL

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1 Revision history

Version	Date	Changed by	Comments
1.0.0	04.09.2023	Maya Green (MYE)	First published version of the guide
1.1.0	20.09.2023	Maya Green (MYE)	Added: - Added section 4.5 about ECP - Added section 4.2.2 about bid availability acknowledgement from BRP to TSO Changed: - Changed the sending of the bid availability document from 1 minute after validity period to unspecified timing
1.1.1	08.03.2024	Maya Green (MYE)	Changed: - Changed the schema version for ReserveBid_MarketDocument in chapter 5.1 from 7:4 to 7:4:1
1.1.2	01.05.2024	Maya Green (MYE)	Changed: - Changed the schema version for ReserveBid_MarketDocument in chapter 5.1 to allow both version 7:4 and 7:4:1 - Changed the registeredRessource.mRID of the bid document include an empty string

2 Scope

This document covers the implementation of aFRR Energy Market and provides information about the processes required to support this market. Both functional and technical aspects are covered. The intended users of this document are the participating BRPs.

The main processes described are:

- Bid submission process, including
    - CIM-based xml message format
- Bid unavailability process
    - CIM-based xml message format
- Bid activation process
    - real-time signal

3 Terms and definitions

Acronym	Term	Definition
AOF	Activation Optimization Function	The role to operate the algorithm applied for the optimization of the activation of Balancing Energy bids within a Coordinated Balancing Area.
BEGCT (BRP GCT)	Balancing Energy Gate closure time	The point in time when submission or update of a balancing energy bid is no longer permitted
BEGOT (BRP GOT)	Balancing Energy Gate opening time	The first point in time when submission of a balancing energy bid is permitted
BRP	Balance Responsible Party	A market participant or its chosen representative responsible for its imbalances
BSP	Balancing Services Provider	A market participant with reserve-providing units or reserve-providing groups able to provide balancing services to TSOs In Denmark the BSP role has not been separated from the BRP role. Whenever the term BSP is used throughout this document it should be interpreted as BRP
CIM	IEC Common Information Model	A standard for describing information about an electrical network. The European style market profile is a profile derivation from the CIM to harmonize the energy market data exchanges in Europe.
CMOL	Common Merit Order List	A combined list of local balancing energy bid lists (MOL) from each price area maintained by the PICASSO platform

CZC	Cross Zonal Capacity	The cross-zonal transmission capacity between two bidding zones
FAT	Full Activation Time	The period between the activation request by the connecting TSO and the corresponding full delivery of the concerned product
FRCE	Frequency Restoration Control Error	PICASSO platform calculates every optimization cycle a frequency restoration control error for each LFC area. This error acts as an input for the LFC optimization calculation. The sign convention is: positive value where the LFC area is in power surplus and indicates that negative aFRR balancing energy needs to be activated; and negative value where the LFC area is in power deficit and indicates that positive aFRR balancing energy needs to be activated.
ECP	Energy Communication Platform	Reference implementation of MADES standard
ETP	Entso-E Transparency Platform	The ENTSO-E Transparency Platform is an online data platform for European electricity system data
ISP	Imbalance Settlement Period	The time unit for which balance responsible parties' imbalance is calculated
LFC	Load Frequency Control	A TSO system to maintain reasonably uniform frequency, to divide the load between the generators and to control the tie-line interchange schedules. Receives input from the PICASSO platform and distributes aFRR control signal to BSP's within the LFC area.
LFC AREA	Load Frequency Control Area	The control area to which the aFRR providing units or aFRR providing groups shall deliver the aFRR standard balancing energy.
LMOL	Local Merit Order List	After the BEGCT the TSO creates a merit order list consisting of balancing energy bids from the BRP's in the respective LFC area which will be sent to PICASSO platform.
MADES	Market Data Exchange Standard	Communication IEC standard designed by ENTSO-E
MOL	Merit Order List	A list of balancing energy bids sorted in order of their bid prices, used for the activation of those bids
MTU	Market Time Unit	The period for which the market price is established as a result of PICASSO platform optimization cycle. For PICASSO the MTU is 4 seconds.
CC	Control Cycle	Period in which a single optimization result is calculated in LFC and new control signals (if changed from previous cycle) are sent from TSO to BRP's
OC	Optimization cycle	Period in which a single optimization result is calculated in PICASSO platform and new FRCE values are sent to each LFC area. Current optimization cycle is 4 seconds.
TSO	Transmission System Operator	A party that is responsible for a stable power system operation (including the organisation of physical balance) through a

		transmission grid in a geographical area. In the Nordic synchronous area, there are four TSOs: Svenska kraftnät, Fingrid, Energinet and Statnett.
	Connecting TSO	The TSO that operates the scheduling area in which balancing service providers and balance responsible parties shall be compliant with the terms and conditions related to balancing;
TSOGCT	TSO energy bid submission gate closure time	The latest point in time when a connecting TSO can forward the balancing energy bids received from a balancing service provider to the activation optimization function
VP	Validity Period	The time period when the balancing energy bid offered by the BSP can be activated, whereas all the characteristics of the product are respected. The amount of time for which a bid is valid and firm. The first validity period of each day begins right at 00:00 market time. Validity periods are consecutive and not overlapping. The length of a single validity period is 15 minutes.

4 Business context

Medio 2024 both DK1 and DK2 will join PICASSO – the European platform for aFFR Energy Activation. The current LFC activation model, which is based on pro-rata activation of capacities, will then be replaced by a European energy activation market. This will introduce a clear split between procurement of aFRR capacity and aFRR activation – exactly as we know it from the mFRR markets.

This guide describes all message flows and realtime signals a BRP needs to support in order to join the aFRR Energy Activation Market. Notice that the PICASSO platform is based on a TSO centric model which means that interaction with the platform is handled entirely by the TSO. BRP interaction will always be through the TSO – never directly with the platform.

4.1 Business processes

The aFRR energy market process starts at the BEGOT, which is 30 days before T (T is the start of the validity period), and ends with settlement and invoicing.
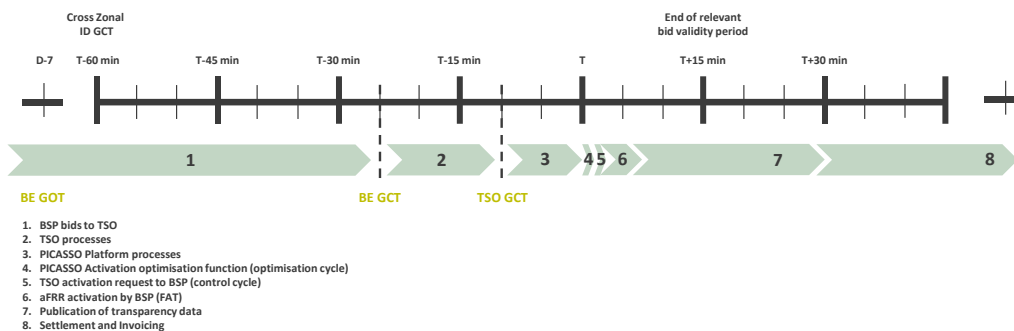

1. BSP bids to TSO
2. TSO processes
3. PICASSO Platform processes
4. PICASSO Activation optimisation function (optimisation cycle)
5. TSO activation request to BSP (control cycle)
6. aFRR activation by BSP (FAT)
7. Publication of transparency data
8. Settlement and Invoicing

Figure 1 The timing for the bidding and activation processes

BRPs send aFRR energy bids to the TSO between BEGOT and BEGCT. BRPs are responsible for activating aFRR energy bids according to the real-time signal received from the TSO. Activation follows the standard product for aFRR energy and new value can be received for each control cycle during the bid validity period.

TSOs then submit local merit order lists of aFRR energy bids to PICASSO platform until TSOGCT.

TSOs send aFRR demand to PICASSO AOF as a real-time signal. The AOF fulfills TSOs aFRR demands by selecting optimal set of bids on the common merit order list for each optimization cycle given the constraints (cross-border capacity limits). The AOF then delivers results real-time to TSOs, which send real-time aFRR activation signals

to BRPs each control cycle. The BRP answers the activation signal with a real-time current activation signal.

Publication of transparency data of the aFRR Energy Market is done on ENTSO-E Transparency Platform.

Settlement and invoicing is handled by each TSO, for Energinet this task has been outsourced to the common Nordic settlement service provider eSett.

The sequence diagram below shows the messaging order of the bidding process. Note that the blue arrows, showing the signals for the activation, runs on a different cycle than the rest of the process.
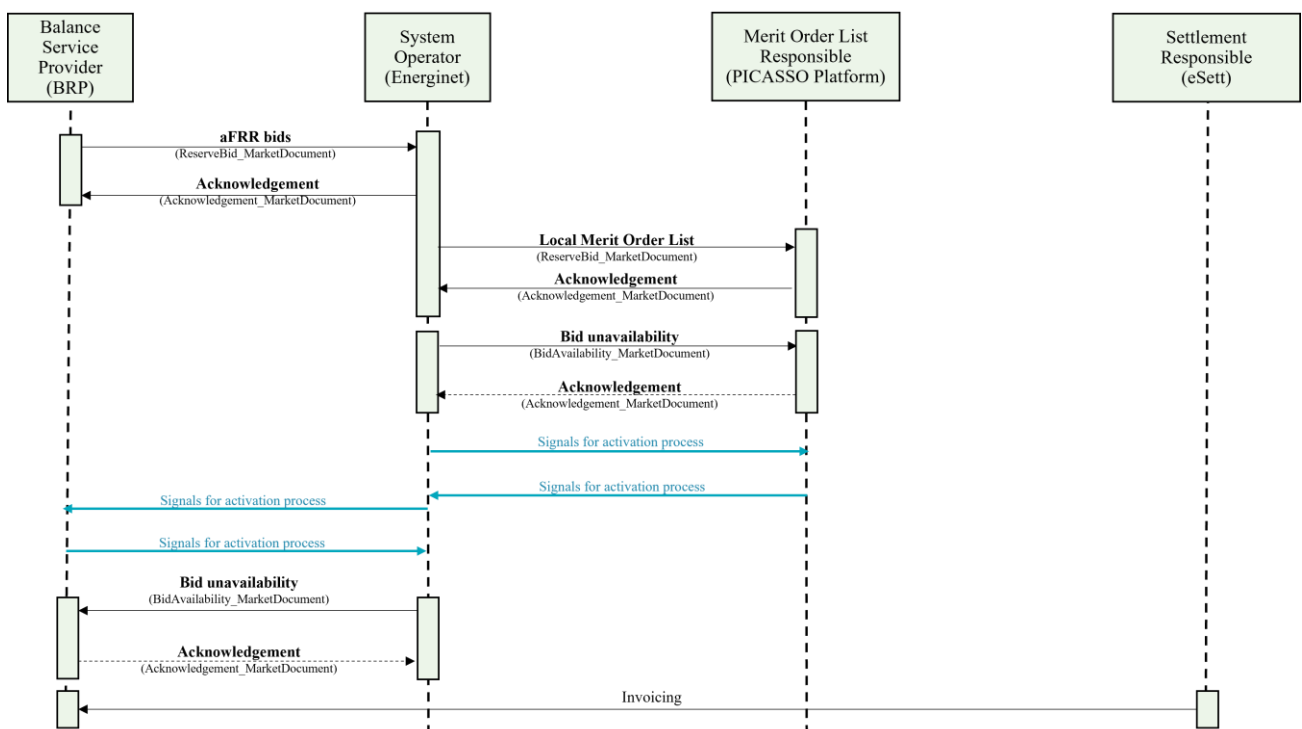
Figure 2 Sequence diagram for the aFRR Energy Market

4.1.1   Bid submission process

Bids can be submitted in the ENTSO-E CIM *ReserveBid_MarketDocument*. A bid is placed in the market when the TSO has provided a positive *Acknowledgement* refer-ring to the bid document.

BEGCT for bid submission is 25 minutes before delivery time.

Each bid must be identified by a globally unique identifier (*mRID*). Two bids are not allowed to share the same bid ID.

The main bid characteristics and bid attributes used in the aFRR energy activation market are described in the table below.

Currency	EUR
Maximum price	15.000 EUR/MWh
Price granularity	0.01 EUR
Minimum bid size	1 MW
Maximum bid size	9999 MW
Bid granularity	1 MW
Bid time resolution	15 minutes

The FAT[1] is described by the attribute *activation_ConstraintDuration.duration*. A FAT longer than 5 minutes is not allowed.

So called *geotags* will be mandatory. A geotag refers to a 400kV, 220kV, 150kV (DK1) or 132kV (DK2) substation and is used by the BRP to indicate where the bid feeds into the grid. If a bid feeds into a substation on a lower voltage level (60kV/50kV) the coresponding 150kV/132kV substation must be used as geotag. Geotags are used by the TSO when handling local congestions in the grid. A bid must have at least one geotag but can have as many geotags as needed – to support portfolio-based bidding. Adding geotags to a bid is done by providing a comma separated list of substations in the attribute *registeredResource .mRID.* A complete list of valid substations will be available as download together with this guide.

Description of all the attributes used in the bid submission message can be found in section 5.1.

4.1.2 Update and cancellation of bids

To update or cancel bids previously sent a new *ReserveBid_MarketDocument* is sent with the following information:

1. A new unique document mRID (document identification)

2. Fixed revision number (always equal to '1')

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[1] Full Activation Time. Includes time for both preparation and ramping.

3. A newer created date-time than the previously sent document

Updates are done by sending the affected time series with new data. Cancellation of time series is done by sending value 0 for quantity. To ensure update of the correct time series the bid identification of the original time series must be used.

When updating or cancelling bids only the updated bids should be sent in a new bid message. There is no need to resend unchanged bids.

It is not allowed to include bids for time intervals that are closed for bidding in a bid message.

4.1.3 Bid acknowledgement

When a BRP submits a *ReserveBid_MarketDocument* to the TSO the TSO will return an *Acknowledgement* document.

If all bids in the bid document are valid a positive *Acknowledgement* will be returned. If one or more of the bids in the bid document are invalid, a negative Acknowledgment will be returned and all bids in the document will be rejected. The negative *Acknowledgement* will contain error codes and text that indicate the reason for why the bids are not valid.

Description of all the attributes used in the acknowledgment message can be found in section 5.2.

4.2 Bid availability process

TSO has a possibility to change the availability status of a bid. By default, all bids have status available. TSO can declare a bid or all bids of a BRP unavailable. Reasons for unavailability can originate from automatic procedures in LFC (e.g. losing real-time connection towards the BRP) or manual actions done by the TSO operator. TSO operator can also declare a bid unavailable on request from the BRP. A bid can also be partly unavailable during the validity period.

If a bid is declared as unavailable by the TSO, the BRP is informed about this through a bid availability document that is sent to the BRP. The document is sent after the validity period of the bid. The BRP will receive a bid availability document if there were bids from that BRP that were partly or fully unavailable during the validity period. If there are no unavailabilities, the document is not sent.

4.2.1 Bid availability report

Submitted bids must be available for activation ordering. If bids become unavailable for activation before BEGCT for any reason, the BRP must cancel the bids. In case bids

become unavailable for activation after BEGCT, the BRP must inform the TSO as quickly as possible by phone.

The TSO will assess the availability of activation for each bid for each market period.

The TSO can mark a bid unavailable for the following reasons:

1. local congestions

2. unavailability of the BRP electronic ordering process

3. BRP informs TSO that bid is unavailable due to failure on reserved delivery unit

4. System security

The TSO will inform the BRP about bids that have been marked unavailable for activation by sending a *BidAvailability_MarketDocument*.

Description of all the attributes used in the bid availability message can be found in section 5.3.

4.2.2   Bid availability acknowledgement

When the TSO sends a bid availability report to the BRP the BRP must return *Acknowledgement* upon receival.

If the document is correctly received and understood a positive *Acknowledgement* must be returned. If not, a negative Acknowledgment must be returned.

Description of all the attributes used in the acknowledgment message can be found in section 5.2.

4.3   Validation rules

Document level

- The bid document must be submitted by the BRP and received by the TSO after the BEGOT and before the BEGCT of every bid in the document.

- There will be a technical validation of the documents according to the document schema. This applies to all the documents described in section 5.

- It will be validated that the document attributes comply with the specifications. This applies to all the documents described in section 5.

All bids:

- Bid size and resolution

- Price resolution

- Time period is within the document time period

Bid updates:

- The time period of a bid cannot be changed. If a bid has been submitted with incorrect time period the bid must be cancelled and a new bid (with new bid identification) must be submitted for the correct time period.

4.4 General rules for messaging

4.4.1 Date and time

Date and Times are based on ENTSO-E Standards and shall be expressed in universal time (UTC+0) in compliance with ISO 8601 as YYYY-MM-DDThh:mm:ssZ. The last 'Z' stands for Zero and indicates UTC+0.

4.4.2 Document coverage

The beginning and ending date and time of the period covered by the document must be on the same CET/CEST day.

4.4.3 Unique identifiers - UUID

Unique identifiers should be proper UUIDs as per RFC 4122 (UUID v1, v4 or v5).

4.4.4 Document identification and revision number

The document identification must be unique over time for the sender in question and should be a proper UUID. The document identification will then not have any significant meaning. The revision number is not used and shall always be equal to '1'.

4.4.5 Message size limit

The maximum allowed number of time series in a message is 2000.

If a BRP wants to submit more bids than this limit the bids must be split into several messages.

The upper limit of number of bid messages sent from a BRP during one bid validity period is 100.

4.5   Energy Communication Platform

All messages described in this implementation guide must be sent over the Energy Communication Platform (ECP).

Information about ECP and how to use it can be found here https://ener-ginet.dk/el/elmarkedet/kom-i-gang-med-ecp/

4.5.1   Bid submission

The bid submission messages must be sent to an EDX[2] service named DK-EAM-AFRR and the messages must have the ECP message type ENDK-AFRR-CIM-PTA51-MTA37

4.5.2   Bid submission acknowledgement

The acknowledgement sent from the TSO as a response to the BRP bid submission message will have the ECP message type ENDK-AFRR-CIM-PTA51-MTA37-ACK

4.5.3   Bid availability

The bid availability document sent to the BRP will have the ECP message type ENDK-AFRR-CIM-PTA51-MTB45

4.5.4   Bid availability acknowledgement

The acknowledgement the BRP sends to the TSO as a response to receiving the bid availability document must be sent to an EDX[2] service named DK-EAM-AFRR and must have the ECP message type ENDK-AFRR-CIM-PTA51-MTB45-ACK

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[2] EDX is an extension of the ECP an provides additional functionality

5 Document attributes and dependencies

This chapter provides the attributes and dependencies for the documents discussed in this guide.

The following classification is used for the attributes:

- M – Must be used

- D – Must be used if a defined condition is met

- O – Optional, can be used

5.1 Bid document – Attributes and dependencies

Note that two schema versions of the bid document are allowed. This is to accommodate BRP's using version 7.4.1 in mFRR EAM.
The changes in version 7.4.1 are not used in aFRR EAM and the two versions are equally allowed.

ReserveBid_MarketDocument		urn:ediel.org:7:reservebiddocument:7:4 urn:ediel.org:7:reservebiddocument:7:4:1
mRID	M	Unique identification of the document. Proper UUID is required.
revisionNumber	M	Constant value of 1
Type	M	A37 – Reserve bid document
process.processType	M	A51 – Automatic frequency restoration reserve (aFRR)
sender_MarketParticipant.mRID	M	EIC code of the BRP sending the document.
Sender_MarketParticipant.market-Role.type	M	A46 – Balancing Service Provider (BSP) (The BRP act as BSP and must use the BSP role)
receiver_MarketParticipant.mRID	M	10X1001A1001A248 (EIC code for Energinet)
receiver_MarketParticipant.market-Role.type	M	A34 – Reserve Allocator

createdDateTime	M	Date and time of document creation (in ISO 8601 UTC format) YYYY-MM-DDTHH:MM:SSZ
reserveBid_Period.timeInterval	M	The period covered by the document (in ISO 8601 UTC format) Start: YYYY-MM-DDTHH:MMZ End: YYYY-MM-DDTHH:MMZ
domain.mRID	M	EIC identification of the Control Area 10Y1001A1001A796 (Denmark)
subject_MarketParticipant.mRID	M	EIC code of the BRP sending the document.
Subject_MarketParticipant.market-Role.type	M	A46 – Balancing Service Provider (BSP) (The BRP act as BSP and must use the BSP role)
BidTimeSeries		
mRID	M	Unique identification of the bid. Proper UUID is required.
Auction.mRID	O	Constant value of AFRR_ENERGY_ACTIVATION_MARKET
businessType	M	B74 – Offer
acquiring_Domain.mRID	M	The EIC identification of the LFC area where the resource is located. 10YDK-1--------W (DK1) 10YDK-2--------M (DK2)
connecting_Domain.mRID	M	The EIC identification of the bidding zone where the resource is located. 10YDK-1--------W (DK1) 10YDK-2--------M (DK2)

quantity_Measurement_Unit.name	M	MAW – megawatt
currency_Unit.name	M	EUR – euro
Divisible	M	A01
Status	M	A06 – Available A11 – Unavailable
registeredResource.mRID	M	List of geotags indicating where the bid feeds into the grid. Comma separated list of 400kV, 220kV, 150kV (DK1) or 132kV (DK2) substations. At least one substation must be provided, but if the bid feeds into different points in the grid (as with portfolio-based bids), all relevant substations must be provided. All substations in the list must be situated in the same bidding zone as the bid itself. An empty geotag list (an empty string) is allowed and will be interpreted as "all geotags in the bidding zone".
flowDirection.direction	M	A01 – Up A02 – Down
energyPrice_Measure_Unit.name	M	MWH – Megawatt hours.
Activation_ConstraintDuration.duration	M	Activation time – time for full activation of the physical resource including preparation time and ramping time. E.g. PT5M – if full activation time is 5 minutes.
Standard_MarketProduct.marketProductType	M	A01 – Standard product
Series_Period – exactly one instance per BidTimeSeries		
timeInterval	M	Period covered (in ISO 8601 UTC format). Must be exactly 15 minutes. There must be one, and only one, period for each Bid_TimeSeries. Start: YYYY-MM-DDTHH:MMZ

		End: YYYY-MM-DDTHH:MMZ
resolution	M	The time resolution – must be PT15M
Point – exactly one instance per Series_Period		
Position	M	Position is always 1
quantity.quantity	M	Offered quantity with 1 MW precision – minimum quantity is 1 MW and maximum quantity is 9999 MW - or 0 if bid is canceled
energy_Price.amount	M	The price of the product offered. Precision is 0.01

5.2 Acknowledgement document – Attributes and dependencies

Acknowledgement_MarketDocument		iec62325-451-1-acknowledgement.xsd –version 8.1
mRID	M	Unique identification of the document.
createdDateTime	M	Date and time of document creation (in ISO 8601 UTC format) YYYY-MM-DDTHH:MM:SSZ
sender_MarketParticipant.mRID	M	EIC identification of the party sending the document.
sender_MarketParticipant.market-Role.type	M	*One of:* **A04** – System Operator **A46** – Balancing Service Provider (BSP)
receiver_MarketParticipant.mRID	M	EIC identification of the party receiving the document.
receiver_MarketParticipant.market-Role.type	M	*One of:* **A04** – System Operator **A46** – Balancing Service Provider (BSP)
received_MarketDocument.mRID	M	The unique identification of the received document.
received_MarketDocument.revisionNumber	M	The revision of the received document.
received_MarketDocument.type	M	The type of the received document.
received_MarketDocument.process.processType	M	The process **type** of the received document.
received_MarketDocument.createdDateTime	M	The date and time of the creation of the received document.
Reason – one or more instances		
code	M	**A01** – Message fully accepted **A02** – Message fully rejected
text	O	May be populated to provide additional explanation in free text format.

5.3 Bid availability document – Attributes and dependencies

BidAvailability_MarketDocument		urn:iec62325.351:tc57wg16:451-n:bidavailabil-itydocument:1:1
mRID	M	Unique identification of the document. Proper UUID is required.
revisionNumber	M	Constant value of **1**
Type	M	**B45** – Bid availability document
process.processType	M	**A51** = automatic frequency restoration reserves
sender_MarketParticipant.mRID	M	10X1001A1001A248
sender_MarketParticipant.marketRole.type	M	**A04** – System Operator
receiver_MarketParticipant.mRID	M	Identification of the party receiving the document
receiver_MarketParticipant.marketRole.type	M	**A46** – Balancing Service Provider (BSP)
createdDateTime	M	Date and time of document creation (in ISO 8601 UTC format) YYYY-MM-DDTHH:MM:SSZ
time_Period.timeInterval	M	The period(s) covered by the bid(s) referenced in the document (in ISO 8601 UTC format) Start: YYYY-MM-DDTHH:MMZ End: YYYY-MM-DDTHH:MMZ
BidTimeSeries – one or more instances		
mRID	M	Unique identification of the bid
bidDocument_MarketDocument.mRID	M	Bid document that contained the bid time series
bidDocument_MarketDocument.revision-Number	M	Version number of the bid document
requestingParty_MarketParticipant.mRID	M	EIC code of Party that requested the update of bid availability

requestingParty_MarketParticipant.market-Role.type	M	**A46** – Balancing Service Provider **A49** – Transmission System Operator **A50** – Distribution System Operator
businessType	M	**C40** – Conditional bid **C41** – Thermal limit **C42** – Frequency limit **C43** – Voltage limit **C44** – Current limit **C45** – Short-circuit current limits **C46** – Dynamic stability limit
domain.mRID	M	The EIC identification of the bidding zone where the resource is located **A01** – EIC coding scheme
Reason – exactly one instance per time series		
Code	M	- When business type = C40 the following reason only applies: B16 = Tender unavailable in MOL list - When business type = C41 or C44 the following reason only applies: B46 = Internal congestion - When business type = C42 one of the following reasons apply: B58 = Insufficiency of reserves B59 = Unavailability of reserve providing units - When business type = C43, C45 or C46 one of the following reasons apply: B18 = Failure B46 = Internal Congestion B47 = Operational security constraints B60 = Unavailability of automatic protection systems
text	O	May be populated to provide additional explanation in free text format

6 Realtime communication

When a bid has been submitted, following the process described above, the balance responsible is required to perform activation as requested by Energinet. Energinet currently supports two protocols for exchange of signals in real-time – TASE2 and IEC 60870-104. Three signals will be exchanged in the new setup after PICASSO go-live the three signals can be seen in the table below. Be advised that the resolution is lower than the minimum bid size meaning that all aFRR bids are fully divisible.

Please observe that the signal requirement is different than the current requirement, thus all BRPs must perform changes to participate in the market after PICASSO connection.

Name	Description	Sender/receiver	Unit	Resolution	Frequency
Set-point	Requested activation	LFC-> BRP	MW	0.001	When changes happen
Activation	Current actual activation	BRP -> LFC	MW	0.001	<1.2 s
Heartbeat	Periodic, binary alternating signal	BRP->LFC	0/1	N/A	<1.2 s

If the balance responsible does not have an established connection to exchange real-time signals with Energinet the process starts by contacting Energinet by email electricitymarket@energinet.dk after which Energinet will start the process of setting up a real-time connection with the balance responsible. When the process is started Energinet will share relevant technical documents and guides with the balance responsible.

The process will take approximately 1-2 months from initial contact. If the connection is already established the process only requires changing the signals exchanged.

Energinet will offer both connectivity testing and end-2-end testing before the switch to PICASSO.