mFRR Energy Activation Market platform – Bid selection process

NBM Stakeholder meeting

03.06.21

Visit nordicbalancingmodel.net
TSO-plan for bid selection process and algorithm description for mFRR EAM

Nordic TSOs will follow the European regulation regarding publishing algorithm description:

- According to EBGL Article 12, publish description of algorithm at least one-month prior application;
- Nordic algorithm description will be aligned with the description of algorithm for MARI platform.

The description of Nordic platform algorithm will be developed in several steps:

1. Description of bid selection process by Nordic platform - slide deck, presented today;
   - Presentation today will focus on selected topics;
   - Will be presented at the Nordic mFRR EAM webinar on Implementation Guide updates:
     - Invitation to webinar on updated Implementation Guide for market participants in the common Nordic mFRR energy activation market – nordicbalancingmodel

2. A memo describing algorithm will be published during Q4 2021 and updated continuously;

3. Algorithm description will be finalized and published one-month before go-live of the Nordic mFRR Energy activation market platform.
Bid selection process description

31.05.21

Visit nordicbalancingmodel.net
Outline

• Introduction - Nordic Balancing Model roadmap.
• Automated mFRR energy activation market – product and process.
• Principles of Nordic mFRR energy activation platform.
• Overview of the Nordic bid selection process:
  • Inputs;
  • Bid preprocessing: attributes and bid filtering;
  • Bid selection for scheduled and direct activation, and fallback.
• Price determination and activation and imbalance pricing and settlement.
Nordic mFRR Energy Activation market project – timeline

- Preparation for operation
- Transitional period
- Nov 2022: Automated operation, pre-15 minutes ISP
- Jun 2023: 15 minutes ISP and preparation for MARI
- Connection to MARI
Transition from today’s processes to common European balancing processes

Today –
• Manual process
• 60 min (24 gate closures/day)
• Time to agree on actions on phone
• Call IT, when needed

Future –
• 15 min (96 gate closure/day)
• Smaller bid size
• Automated bid selection process
• Electronic ordering
• Observations
• Situational awareness
• Intervene only when needed
• IT support in control room
Three steps towards connection to the European mFRR energy activation platform MARI

1. **60 min ISP Frequency based**
   - mFRR EAM Project
   - 15 min ISP
   - Shift from 60 min manual to 15 min automated balancing.
   - Changes in bidding and activation processes and product-requirements.

2. **Automated operation pre15-min ISP**
   - 15 min ISP project
   - Shift from 60 to 15 min ID market and ISP.
   - Changes in pricing and settlement of mFRR energy and imbalances.

3. **15 min ISP ACE based**
   - Connect to MARI
   - Nordic TSOs prepare for connection to the European mFRR energy activation market and platform MARI.
Standard mFRR energy product in the European and Nordic automated activation market

Delivery period

Time of electronic order

Full activation time (FAT)

15 min

mFRR standard product
Standard product: scheduled- and direct- activation

1. Preparation period
2. Ramping period
3. FAT – full activation time
4. Minimum duration of delivery period (5 min)
5. Maximum duration of delivery period:
   a) 5 min in scheduled activation
   b) 20 min in direct activation
Automated Nordic mFRR energy activation market process

From go-live Automated Operation pre 15 minutes ISP

Submit bids

Filter bids

Select bids

Verify

Activate bids

* For all four quarters in the next hour
Principles of Nordic mFRR energy activation platform

• Common Nordic platform:
  • Nordic mFRR platform will support Scheduled activation with an algorithm similar to European platform MARI;
    • Information about MARI platform can be found here: [MARI PICASSO workshop July 2020](#) and [MARI workshop December 2020](#)
  • There will also be exchange of energy for Direct activation between TSOs before connecting to MARI, this will be a rule-based bid selection;

• TSO-TSO model:
  • Exchange of balancing energy is between TSOs.

• TSO-BSP model:
  • BSPs have contact with local TSO and not with common Nordic platform.

• Each TSO will in addition have support for local bid activation, as a fall-back.

• When connected to MARI:
  • Scheduled- and Direct activation optimisation will be handled by MARI platform;
  • TSO local fall-back will be used also when connected to MARI;
  • Limited changes for TSOs;
  • No known changes for BSPs.
Bid selection process – overview

- Imbalance forecast
- ATC after ID
- BSP bids

⇒

- Bid collection and bid filtering
- mFRR Request

⇒

- mFRR ATC
- Common bid selection scheduled activation (AOF)
- Common bid selection with direct activation (no-AOF)
- Local bid selection (fallback)

⇒

- Activate (electronic ordering)

⇒

- Pricing, Settlement & transparency

NBM Nordic Balancing Model

Svenska Kraftnat | ENERGINET | FINGRID | Statnett
• **ATC – available transmission capacity**
  - Trade capacity (remaining capacity after ID) is used. Today it is manual assessment based on thermal capacity and physical flow that is used.
  - ATC can be adjusted by operators only due to system security reasons.
  - Will use all available trade capacity, not considering physical path.

*) MARI documentation use CBCL – cross border capacity limits, in stead of ATC

• **mFRR Request – based on imbalance prognosis**
  - Inelastic demand
    - All demand shall be covered as long as there are available bids (and ATC)
  - Elastic demand has a price limit
    - Algorithm supports elastic demand, but as of now we do not foresee to use it.
Use of bid attributes

- **All bid attributes are necessary because:**
  - Automated bid activation selection (optimization) every 15 min;
  - Algorithm can only use information provided on bids, no manual assessment or sanity check;
  - Bids are selected for each 15 min separately and there is no look-ahead, therefore need for bid linking in time - *technical linking* and *conditional linking*.

- **Bid attributes are used in two steps**
  - **Step 1: Pre-process:**
    - done by the TSOs - to determine which bids that shall be available for the bid selection on platform;
    - Based on bid attributes and other processes (e.g., congestion management)
  - **Step 2: Algorithm run.**
    - Optimize bid activation and satisfaction of balancing demands, given submitted bids (w/attributes) and ATCs.
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Use of bid attributes

- **Step 1: Pre-process. Find out which bids that shall be available for the bid selection on platform:**
  - Use the following bid attributes, set by BSP
    - Activation type (DA or SA only)
    - Conditionally linked bids
    - Technically linked bids
    - Maximum duration – *national*
    - Resting time – *national*
    - Inclusive bid – *national*
    - Slower activation time – *national*
    - Locational information – *national*
  - Bid filtering - TSO can set bids unavailable due several reasons.

- **Step 2: Algorithm run. Optimize given bid (w(attributes)), ATC and demands**
  - Use the following bid attributes set by BSP
    - Minimum offered volume
    - Indivisible attribute
    - Exclusive group bids
    - Multipart (Parent/child) bid
Bid filtering and marking unavailable for mFRR platform activation

- Bid filtering due to internal congestions for operational security (bids marked unavailable for SA and DA selection):
  - Bids that cannot be activated due to internal congestions
  - Bids that are activated to solve internal congestions
- Non-standard products (e.g., bids with longer activation time)
- Guaranteed volume*
- BSP unavailability:
  - BSP electronic availability (based on response to heart-beat signal)
  - On request from BSPs after BSP GCT – due to technical reasons

*Extent of use of GV to be decided
Congestion management

• Before sending bids to the Nordic Platform the TSOs must address the operational security
  • If there are (predicted) congestions in the grid, some bids might be activated to resolve these
  • If some bids can cause a congestion if they are activated, they should be marked as unavailable for activation in the AOF
• This challenge varies significantly between the TSOs. Particularly important in Norway.
• Advanced grid analysis tools will be developed to perform this process. Decisions will be taken with some degree of uncertainty.
Non standard products

• Fingrid and Svenska Kraftnät own strategic reserves today;
• Energinet purchases slower reserves today;
• Nordic TSOs will continue using these reserves for balancing and in case of power system incidents – after go-live of the Nordic automated mFRR energy activation market;
• These non-standard products will not be made available for selection and activation by the Nordic platform algorithms for scheduled and direct activation:
  • they will be made visible in the common Nordic bid list and activated outside the common bid selection when standard products are not sufficient.
Bid selection – scheduled activation

- Common Nordic bid selection for scheduled activation (SA)
  - Algorithm follows the same principles as MARI
  - Exchange between areas only when it gives positive socio-economic result.
    - Normally this will include netting of demand, but it can also imply activation of bids in opposite direction in different areas (counter activation).
    - Counter activation – in one uncongested area select up regulation bids and down regulation bids which are in the money.
  - Algorithm will first find a solution that satisfy mandatory conditions.
  - Then search for other solutions that better satisfy the goal function, within a specified amount of time.

- Mandatory conditions
  - Prevent unforeseeable accepted bids (UABs)
  - Prevent adverse flow (on borders with no desired flow range)
  - Enforce price convergence (on borders with no desired flow range)
    - From an economic point of view, enforcing price convergence for interconnectors is similar to preventing unforeseeable rejected bids (URBs) for bids and needs.
  - Prioritize bids
    - Fully divisible bids and elastic needs have priority over other bids.
    - Elastic needs have priority over fully divisible bids.
Bid selection – scheduled activation

• Goal function for scheduled activation optimisation
  • Maximize satisfaction of inelastic demand.
  • Maximize social welfare.
  • Minimize cross border flow.
  • Maximize traded volumes (bids and needs)
    • Traded volume = accepted quantities.
  • Penalize unforeseeable rejected fully divisible bids (URdB).
Bid selection for direct activation (DA)

- **Common bid selection for direct activation** will be done with a separate solution than for the scheduled activation.
  - In MARI this is done in the same solution.

- **Rule-based bid selection**
  - Rule-based bid selection is somewhat simpler than direct activation in MARI, but the goal is that bid selection result to a large extent will be the same.

- **Direct activation**:
  - In price order evaluate if bid can be used to cover direct activation demand given ATC;
  - With direct activation demand is satisfied for one bidding area and one direction at the time.
Bid selection fall-back – for scheduled activation

- **Common bid selection will be possible even if the primary solution for scheduled activation is unavailable.**

- **Rule-based bid selection**
  - Rule-based bid selection is somewhat simpler than the primary Nordic solution for scheduled activation:
    - The goal is that bid selection result to a large extent will be the same.

- **Fall-back scheduled activation**
  - In price order evaluate if bid can be used to cover demand given ATC.
    - Evaluate for one-by-one bidding areas in sequence, until bid volume is fully used to cover demand, or until all bidding areas evaluated.
Pricing determination – bid selection for SA and DA

• **Price determination for scheduled activation (15 min):**
  - Cross border marginal price – same price in all bidding areas within an uncongested area;
    - In some given situations algorithm can give price indeterminacy and calculation of price is complex.
  - If there are several bids on the margin, all (divisible) bids are selected with pro-rata activation of each bid to fulfill demand.

• **Price determination for direct activation (15 min)**
  - Cross border marginal price for the bidding areas, participating in the bid selection.
Activation and imbalance pricing and settlement

from go-live automatic operation (60 min ISP) until go-live 15 min ISP

• **Activation pricing and settlement**
  - Same activation pricing and settlement principles as today:
    - Hourly marginal price, based on output from SA and DA activation algorithms and calculated in common Nordic pricing module.
    - 15-min balancing activation (scheduled and direct) marginal prices are inputs to 60-min settlement price calculation.
    - One 60-min price per direction – no separate SA and DA settlement prices.
    - Day-ahead price as a cap and floor for mFRR activation settlement price and for hours without activation.

• **Imbalance pricing and settlement**
  - Same principles as from go-live single price:
    - [Single-Price_Common-Market-Design.pdf](nordicbalancingmodel.net)
Thank you for your attention!
Common Nordic bid attributes
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Simple bids

- Valid for one quarter hour
- One quantity and price
- Unique bid ID, use UUID (universally unique identifier)
- Divisibility:
  - Fully divisible bid: Any quantity can be activated
  - Divisible bid: Any quantity between min and max can be activated
  - Indivisible bid: Only full quantity can be activated
Complex bids

**Multipart bid** – activated in strict price order
- All bid components must have
  - Same `multipartBidIdentification`
  - Same direction and activation type
  - Different prices
  - And belong to the same quarter hour

**Exclusive group of bids** – only one bid can be activated
- All bid components must have
  - Same `exclusiveBidIdentification`
  - Same activation type
  - And belong to the same quarter hour

---

**Example use-case: model start-up costs**

![Diagram showing multipart bids and exclusive groups with detailed specifications for each bid component.]
Need for linking of bids in time – direct activation

- Direct activations last until the end of the next quarter hour.
- To avoid double activation it is necessary to link bids for which the underlying asset is the same.

Bid A is direct activated in QH0 and will extend into QH1. Consequently bid B will not be available.
Technical linking
- linking between market periods

- Indicate that bids in consecutive quarter hours belong to the same underlying asset
- The bid selection algorithm will not activate a bid if it has technical link with a direct activated bid in the preceding quarter hour
- Allowed for both simple and complex bids
- A common `linkedBidsIdenification` is used to link the bids

<table>
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<th>QH0</th>
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<tr>
<td>Bid ID</td>
<td>1</td>
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<td>linkedBidsIdenification</td>
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Example of linking of two simple bids:

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<td>3</td>
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<td>bb</td>
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Example of linking of three exclusive group bids (exclusive groups):

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Further needs for linking - ramping constraints

Direct activation in next quarter hour may conflict with ramping constraints

Bid A is scheduled activated in QH0. The ramp down extends into QH1. Direct activation of Bid B requires the underlying asset to ramp up while ramping down.

Bid A is direct activated in QH0. The ramp down extends into QH2. Direct activation of Bid B requires the underlying asset to ramp up while ramping down.
Further needs for linking due to ramping constraints

Activation in opposite direction in next quarter hour

The ramp from upward $X$ MW to downward $-X$ MW requires twice the ramping speed as required for Bid A and Bid B. If the underlying asset is not able to fulfill the faster ramping curve, conditional linking should be used.
Conditional linking
- linking between quarter hours with conditions

- Allowed only for simple bids
- A simple bid can be linked to up to six bids in the two previous quarter hours

For a *Conditionally available* bid each link may specify that the bid is:
- Not available if the linked bid was activated
- Not available if the linked bid was subject to SA
- Not available if the linked bid was subject to DA
- Not available if the linked bid was not activated
- Not available for DA if the linked bid was subject to SA
- Not available for DA if the linked bid was subject to SA

For a *Conditionally unavailable* bid each link may specify that the bid is:
- Available if the linked bid was activated
- Available if the linked bid was subject to SA
- Available if the linked bid was subject to DA
- Available if the linked bid was not activated
- Available for DA if the linked bid was subject to SA
- Available for DA if the linked bid was subject to SA

Example use-cases for conditional linking:
- handle ramping constraints
- model start-up costs
- model changing hydro situations
Nordic national bid attributes
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Maximum duration

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Technical linking of the bids must be in combination with this bid attribute. All the linked bids must have the same maximum duration.

- All four bids are in the money in the particular MTU.
- Bids are "technically linked".
- **Maximum duration is set to 30 min** for all four bids.
- Resting time is set to 15 min for all four bids
Resting time

The BSP can add information on the required minimum duration between the end of deactivation and the following activation.

Technical linking of the bids must be in combination with this bid attribute. All the linked bids must have the same resting time.

- Bids A, C and D are in the money in the particular MTU. Bid B is not in the money and is not selected for activation.
- Bids are “technically linked”.
- Resting time is set to 30 min for all four bids.
Inclusive bids

If one bid is activated, another bid (e.g. a resource downstream) must also be activated.

Example

- Bids A og B are inclusive bids.
- Bids C og D are inclusive bids.
- All four bids are in the money in the particular MTU.
- Bid B is unavailable for activation due to e.g. an internal congestion.

Resulting activation