New aFRR design

Workshop - 15th of May 2019

Introduction

The new aFRR design

Scope

The design in this study facilitate the opening of the aFRR market to all technologies independent of the voltage level they are connected and independent of the type of aFRR provider *.

Important changes:

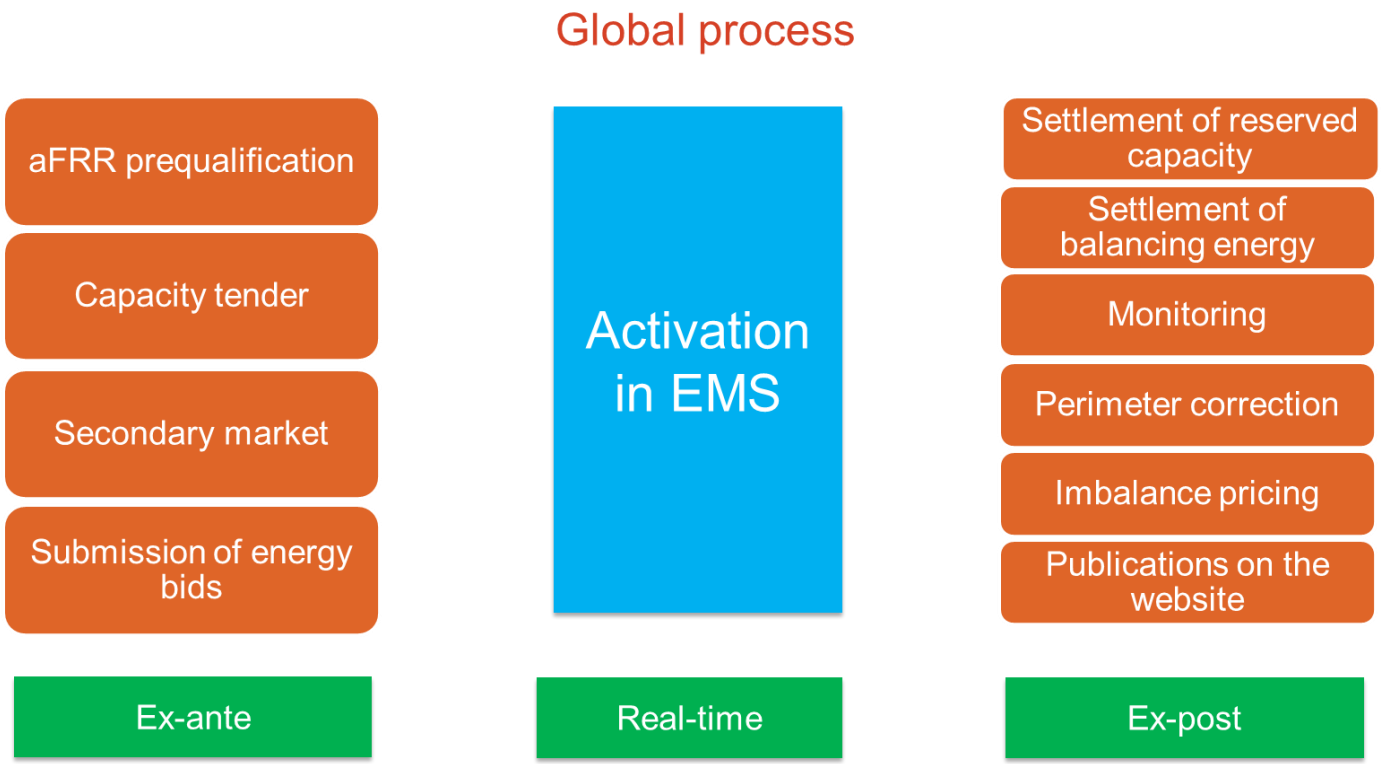
- Contractual opening of the aFRR product to all technologies;
- Separated procurement aFRR and FCR;
- A daily separated procurement aFRR;
- Allowing portfolio based participation;
- A balancing energy gate closure time for the submission of aFRR energy bids close to real time;
- A merit order activation;

Timings

- The go-live of the new aFRR design is foreseen in July 2020
- The prequalification will start at the beginning of May 2020

*subjected to the restrictions in FSP-DSO contract

Global aFRR process



Transfer of Energy

- Elia foresees a postponement of the choice to implement a ToE for aFRR.
- Elia will re-evaluate the need to implement a ToE for aFRR in the course of 2019.

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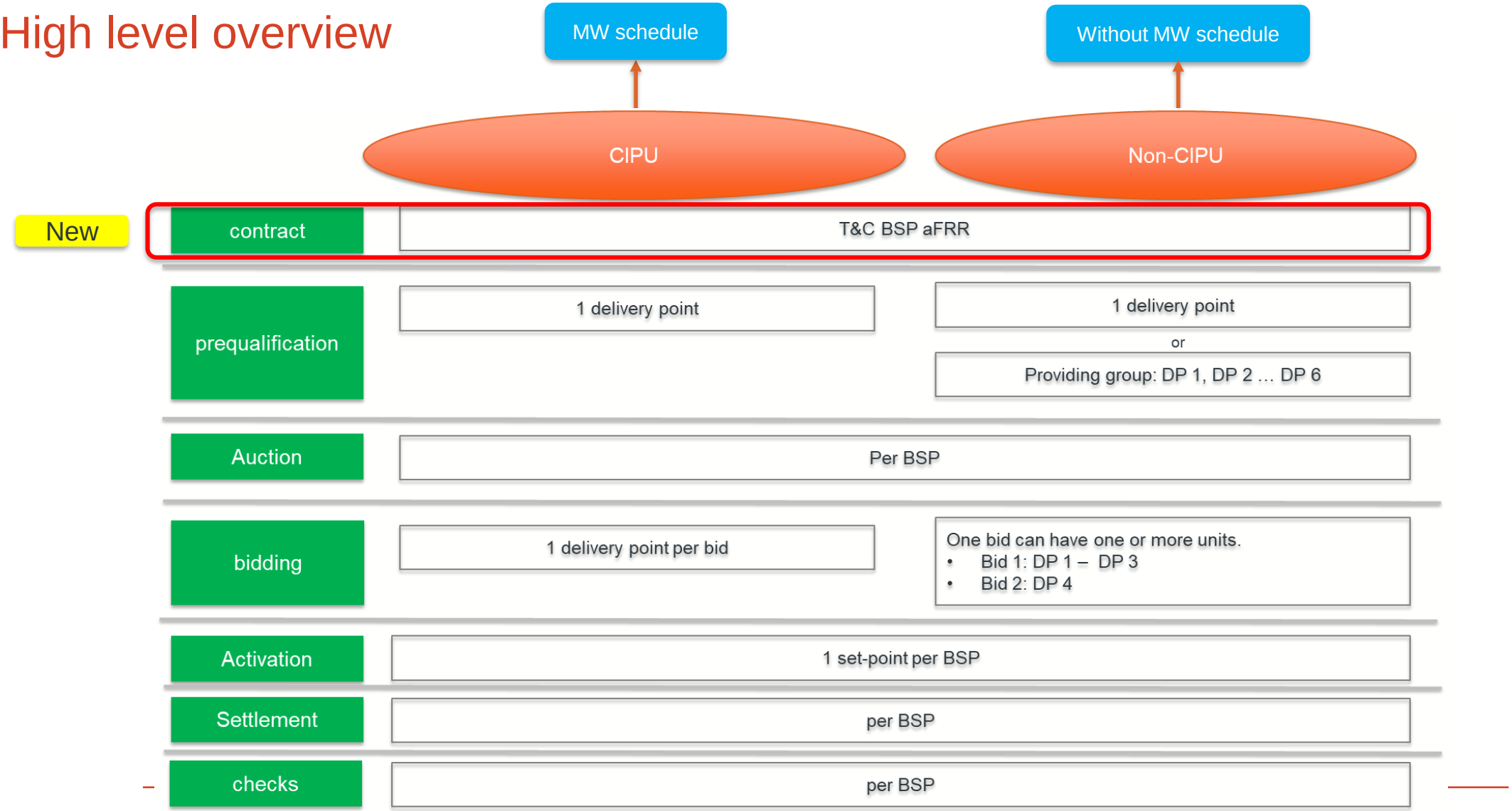
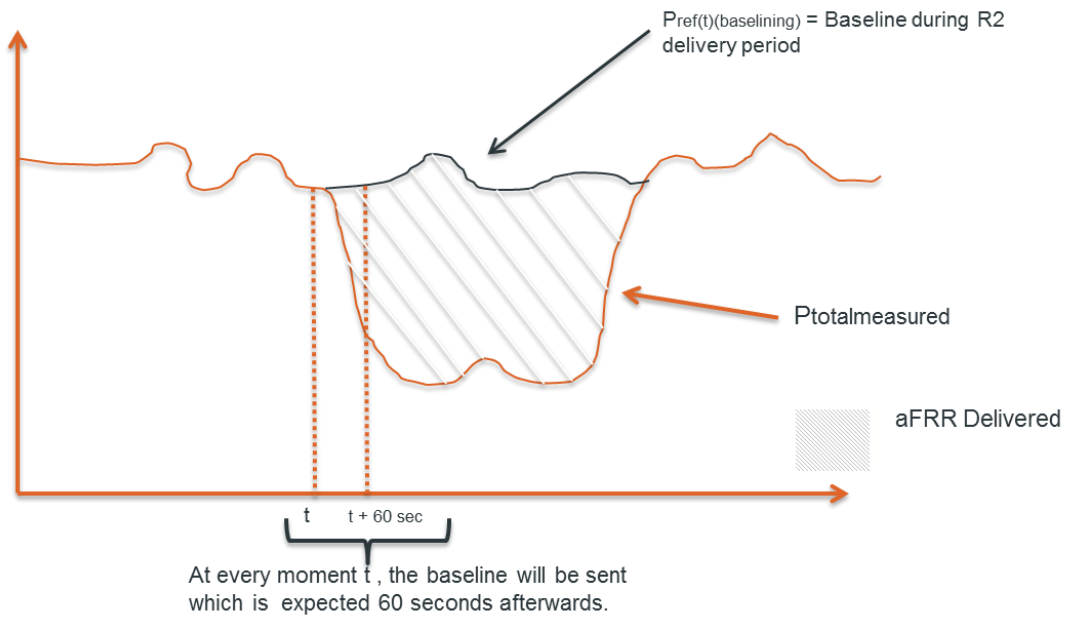
- Key principles of the new aFRR design
- aFRR processes in detail
- Conclusions and next steps

Key principles of the new aFRR design

High level overview



Baseline methodology



- The baseline for aFRR is determined by the aFRR provider and not by Elia.
- The baseline is sent one minute in advance to Elia.
- Elia will re-evaluate the methodology one year after the go-live once sufficient data is available. These results will be discussed with relevant stakeholders.

Data exchange

- Ex-ante
  - Submission of bids for the capacity tender
  - Submission of bids on the bidding platform
- Real-time
  - CIPU: Real-time data exchange via SCADA of Elia
  - Non-CIPU: Real-time data exchange via real-time communication platform

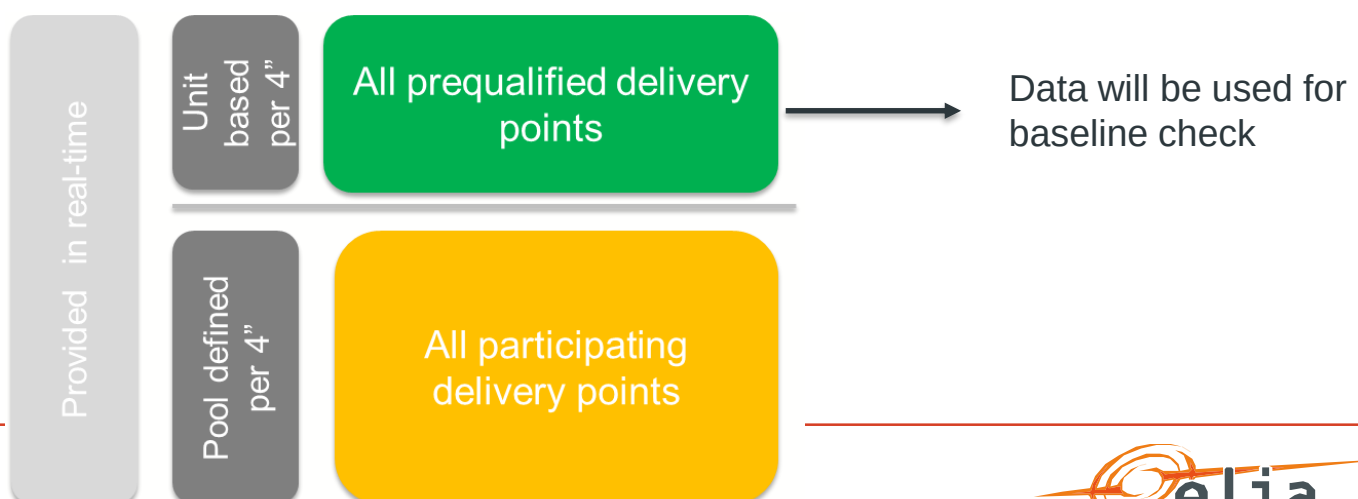
Parameters to be exchanged in real-time

- ΔPsec_tot (control request per BSP)
- Return signal of ΔPsec_tot
- Avail_sec
- Pmeasured
- Pbaseline
- Psec

Real-time data exchange

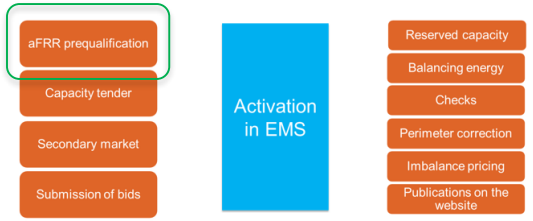
CIPU assets	Non-CIPU assets
• Measurement values collected via Elia RTU • Other parameters (baseline, …) collected via SCADA to SCADA connection. • Aggregation (CIPU + non-CIPU) via SCADA Elia	• Measurement values collected via private device • Other parameter collected via private device • Aggregation (CIPU + non-CIPU) via SCADA Elia

Proposed design



Qualification process

Qualification process

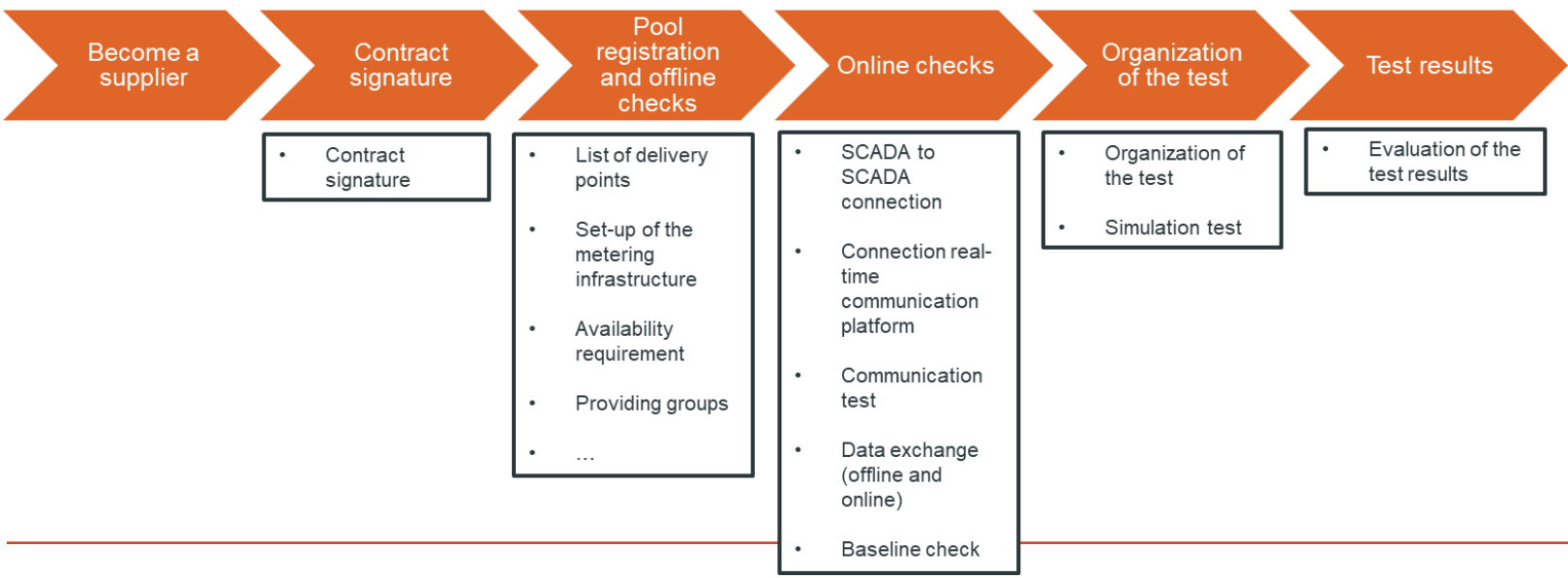


A qualification process has several objectives:

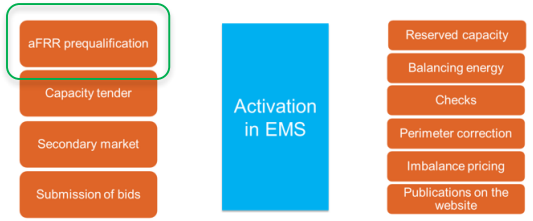
- Check compliancy with **technical, organizational** and **administrative requirement**;
- Check **availability requirements**;
- Determine and test maximal **aFRRmax prequalified volume** (upwards and/or downwards) for each aFRR reserve providing group.

There is a need to go through the prequalification process in the following cases:

- New aFRR delivery points wishing to participate to the aFRR services;
- Existing aFRR delivery points linked to CIPU assets have to do the prequalification test for the new aFRR design, the simulation test however has to be done within 2 years after go-live of the new aFRR design.



Detailed information on providing groups



Only applicable for the prequalification process

Summary of the most important principles

- **Principle 1:**
  CIPU/assets with MW schedule → a providing group can contain only one asset
  Non-CIPU/assets without MW schedule → a providing group can contain more than one asset.
- **Principle 2:**
  A delivery point can only be part of one aFRR providing group.
- **Principle 3:**
  The individual aFRR contribution (upwards & downwards), i.e. the aFRRmax per delivery point per direction will be given by the aFRR provider during the prequalification process.
- **Principle 4:**
  aFRRmax prequalified volume per direction is determined during prequalification process → balancing capacity
  More flexibility can be offered in the energy bids.
- **Principle 5:**
  aFRRmax prequalified volume per providing group is limited and capped to 100MW

Capacity tender

History: Key principles of the capacity tender

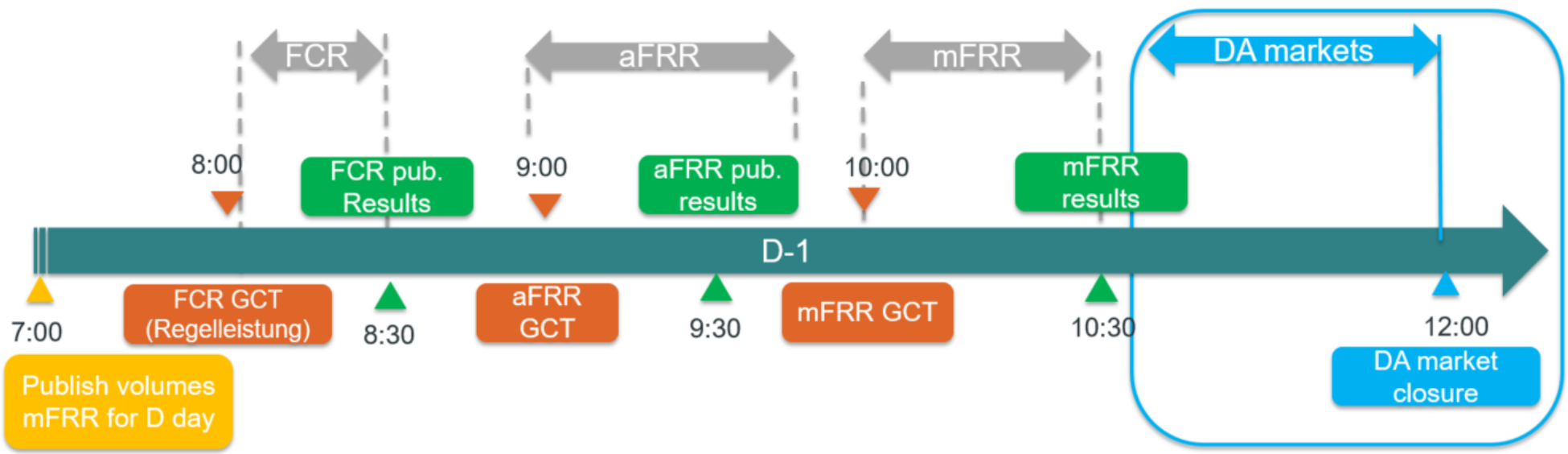
Opening of the aFRR market to all technologies

For Elia, it is key to organize the aFRR capacity market in an efficient way and to make this market attractive for all entrants.

Decisions already taken for the aFRR capacity tender:

- Separated procurement FCR and aFRR
- Daily procurement for aFRR

Timings for the daily procurement:



Fundamental criteria for the aFRR capacity tender methodology

- **Impact on the aFRR cost**:
  The cost of the new aFRR design should remain acceptable (compared to today's budget). Therefore cost risks should be mitigated were possible.

- **Attractiveness for non-CIPU assets**:
  Enable new entrants (eg. Non-CIPU assets) to become active on the aFRR market with small volumes and become selected in case they offer competitive prices.

- **Transparency**:
  The price formation and selection criteria should be transparent in order to facilitate bidding competition.

- **Complexity**:
  The capacity tendering procedure should be organized each day in a period of 30 minutes. Therefore a robust and performant tendering process is required.

Impact of CCGTs

- At the beginning of the opening of the aFRR market to all technologies, CCGTs are still indispensable for the delivery of the aFRR services

- CCGTs have a specific cost structure:
  - Start-up costs
  - Fixed must-run costs
  - Variable must-run costs
  - Opportunity costs

- The combination of opening the aFRR market to non-CIPU units together with taking into account the specific characteristics of the CCGTs is not a straight forward exercise.

- Therefore, Elia has asked the support of an external party for this exercise.

The results of the quantitative assessment are subject to changes depending on the assumptions used and should be interpreted as general tendencies

Definition of start-up costs

- Before a CCGT can feed electricity to the grid, it has to be started up, i.e. ramped up at least to the minimum generation level (Pmin)
- **This comes at a cost independent of how much output is produced**. These costs can be separated into (i**) indirect start-costs** (resulting from wear and tear) as well as (ii) **direct start-costs** (the fuel required to heat up the steam cycle)
- CCGTs try to keep their start-up frequency to a bare minimum in order to avoid wear and tear and ensure operational consistency

Assumptions CCGT start-up costs			Source
Direct start cost	5	€/MW	*
Indirect start cost	40	€/MW	*
Start-up cost	€16750	Per start up	*
Start-up cost	€15000	Per start up	Elia

*Source: « Cycling of conventional power plants: technical limits and actual costs » 2015, Van den Bergh, Delarue

Calculation of start-up costs for 2017 (high level estimations)

- Elia has assumed that always 2 CCGTs are required to deliver the aFRR service.
- Start-up costs for a weekly tender are **1,6M€** (for 2017)
- Potential **additional** start-up costs for a daily procurement are **4,1M€** (from 1,6M€ to 5,7M€)
- In case of a tender with 6 times 4-hour blocks, there is a risk of increase of start-up costs by a **factor 6**

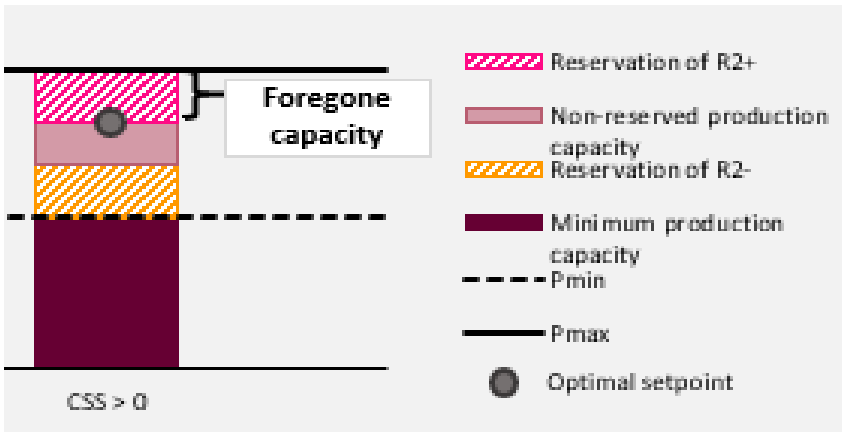
Conclusion

- Today, with a weekly tender, the impact of start-up cost is limited
- If the **granularity of the tender blocks decreases**, the share of the start-up costs becomes more and more important with respect to the total costs for each tender block.
- A design with daily tendering of 4-hour blocks should ideally mitigate risks associated to start-up costs

Cost structure for CCGTs in case of positive clean spark spread

Origin of opportunity costs

- CCGTs are running-in-the-money due to a positive clean spark spread
- **When CCGTs are selected to reserve upward capacity, they cannot use the reserved capacity in the spot market and thus foregone profits**, i.e. they have an opportunity cost for offering aFRR services
- **CCGTs take into consideration their opportunity cost** when submitting their reservation bids for upward reserves to ensure aFRR profits outweigh the potential revenue from the spot market



Mathematical formulation

- ***Opportunity costs = Clean spark spread * Foregone capacity***

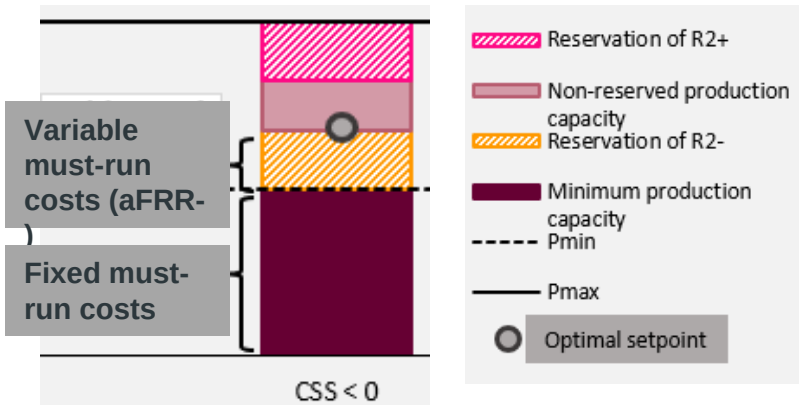
Conclusion

- No specific issue is identified with regards to a daily procurement with 4 hours blocks when the clean spark spread is positive

Cost structure of CCGTs in case of negative clean spark spread

Origin of must-run costs

- When there is a negative clean spark spread, CCGTs **face fixed must-run costs as they have to run at least at Pmin to avoid shut-down**
- These **fixed must-run costs are borne from the moment 1 MW is selected**
- In addition, when reserving downward capacity, **CCGTs face variable must-run costs due to the obligation to run at higher capacity than Pmin**
- CCGTs take into consideration both must-run costs in their aFRR bids



Mathematical formulation

Fixed must run costs = Pmin * Clean spark spread * Number of plants offering aFRR

Variable must-run costs = Clean spark spread * aFRR down capacity offered

Calculation of must-run costs for 2017 (high level estimations):

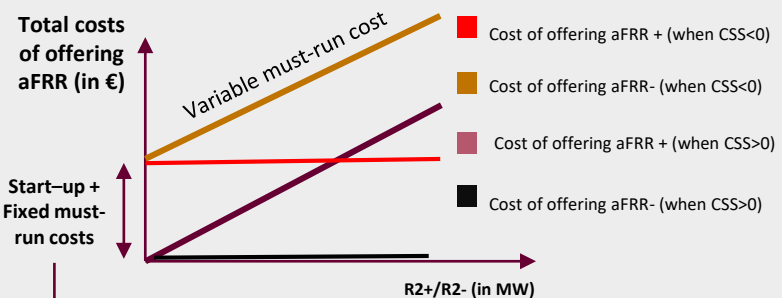
- Fixed must run cost are estimated at 11,6 M€
- Pmin is assumed to be 150MW
- In a total cost optimization, the risk of must-run is covered by a symmetrical procurement.
- An asymmetrical procurement could potentially lead to a doubling of must-run costs (2 times 11,6M€)

Conclusion

- An asymmetric procurement when the clean spark spread is negative can lead to an increase in the sourcing costs of aFRR
- A new aFRR procurement should ideally consider the risks associated to must run costs

Cost structure CCGTs

Illustration of the cost structure of CCGTs



- **When there is a negative CSS, CCGTs** charge very **high prices for the first MW offered** in order to be certain **to recover the fixed must-run cost and start-up costs**
- As a result, **CCGTs have a flat bidding curve when there is a negative CSS**, where the average price per MW decreases as more capacity is offered
- **This flat bidding curve reflects the cost structure of CCGTs but also hampers competition from non-CIPU as CCGTs are able to offer the last MW close to marginal cost**

When there is a negative CSS, fixed costs (must-run costs and potentially start-up costs) are incurred from the 1st MW offered by CIPU

History: Initial proposal for the aFRR capacity tender in the aFRR design note

- **Methodology**
  - Daily procurement
  - Separated procurement for aFRR and FCR
  - 6 blocks of 4 hours
  - Independent total cost optimization for each 4-hour block for aFRR up and aFRR down together

- **Bidding rules:**
  - Bids are offered in €/MW/h
  - Maximum step size of 10MW
  - Obligation to split up large symmetrical bids into smaller symmetrical and asymmetrical bids
  - Total cost rule is applicable

- aFRR design note is **consulted** in September 2018

Feedback public consultation: 6 blocks of 4 hours was not optimal for assets with large start-up costs
- Risk of adding start-up cost for each block of 4 hour
- Risk of cost increase
- Offering 4-hour blocks is not obvious for some technologies due to technical constraints

Conclusion of Elia: This methodology can lead to a potential cost increase when the start-up costs are offered in each 4-hour block (potential cost increase of the start-up costs with a factor 6 with respect to a daily tender).

→ Allow 24-hour blocks for the capacity tender.

History: Updated proposal aFRR capacity tender in aFRR implementation plan

- **The key principles for the capacity tender:**
  1. Combinations of 4-hour blocks and 24-hour blocks — new
  2. 24-hour blocks are obliged to bid also 4-hour blocks — new
  3. A total cost optimization for together aFRR up and aFRR down on a daily basis for the aFRR up and aFRR down direction.

- **The following bidding principles shall be applicable:**
  1. Bids are offered in €/MW/h
  2. Maximum step size of 10MW
  3. Obligation to split up large symmetrical bids into smaller symmetrical and asymmetrical bids
  4. Total cost rule will be applicable for all bids.
- **Additional bidding obligations after consultation**
  1. A dependency between the total cost rule for 24-hour bids and the associated 4-hour bids will be implemented.
  2. A dependency between the total cost rule for symmetric and asymmetric bids will be introduced.

new

aFRR implementation plan is **consulted** in November 2018

Feedback public consultation by stakeholders:

- Some stakeholders encourage 4 hour blocks. If not only 4 hour blocks are offered, bidding rules need to be adapted to incentivize non-CIPU units
- Other stakeholders consider the introduction of the procurement of 24-hour blocks in the design as a huge improvement for CCGT's. It allows a reasonable coverage of the start-up costs of CCGT's.

Conclusion of Elia: This methodology limits the potential cost increase but is suboptimal for non-CIPU assets.

Further steps undertaken by Elia in meantime

Elia has decided to further analyze different options for the aFRR capacity supported by an external party.
The results are shown in the next slides.

- **Investigated methodologies**
  - **Total cost optimization** with 6 blocks of 4-hours (initial proposal)
  - **Total cost optimization** with a combination of 24-hour and 4-hour blocks (updated proposal)
  - **Total cost optimization** with 6 blocks of 4-hours where the start-up costs are offered separately
  - **Merit order selection** with a separated procurement of aFRR up and aFRR down

Reference scenario: Total cost optimization and a daily tender

- **Methodology**
  - Daily procurement
  - one 24-hour block
  - Independent total cost optimization for the 24-hour block for aFRR up and aFRR down together

- **Bidding rules:**
  - Bids are offered in €/MW/h
  - Maximum step size of 10MW
  - Obligation to split up large symmetrical bids into smaller symmetrical and asymmetrical bids
  - Total cost rule is applicable

Level playing field	Cost efficiency	Transparency	Complexity
• Difficult for non-CIPU assets to fulfill an obligation for 24 hours. • Attractive for CIPU assets	• Potential start-up cost: 5,7M€ (start-up costs for a weekly tender is 1,6M€). • Potential must-run costs: 11,6M€	Risk that bids with a price below the average price of the selected bids are not selected	• The algorithm complexity is low • Implementation effort is low

Total cost optimization with 6 blocks of 4 hours

- **Methodology**
  - Daily procurement
  - Separated procurement for aFRR and FCR
  - 6 blocks of 4 hours
  - Independent total cost optimization for each 4-hour block for aFRR up and aFRR down together

- **Bidding rules:**
  - Bids are offered in €/MW/h
  - Maximum step size of 10MW
  - Obligation to split up large symmetrical bids into smaller symmetrical and asymmetrical bids
  - Total cost rule is applicable

Level playing field	Cost efficiency	Transparency	Complexity
• Technically, it is possible to offer bids and Non-CIPU assets can benefit from increased aFRR prices when CIPU do not apply a flat bidding curve • Feasible for CIPU assets	• Risk of having start-up costs in each 4-hour block (**6 blocks * 2 CCGTs**) **→ a potential cost increase from 28,5M€ with respect to the daily tender** • No impact on the must-run costs • Potential cost increase could be diminished due to increased competition.	Risk that bids with a price below the average price of the selected bids are not selected	• The algorithm complexity is low • Implementation effort is low

Merit order selection for aFRR capacity tender

Bidding methodology

- Allow only 4-hour blocks separated for the upward and downward direction
- Merit order selection for each block separately and for each direction separately
- For the 4-hour blocks, a variable cost (in €/MW/h) is added for each 4-hour block for the upward and the downward direction separately.

Divisibility/indivisibility

- Indivisibility is still required to cover asymmetrical must-run costs.
- Part of the offered volume of a bid is divisible without change of prices (€ and €/MW/h) in function of the selected volume.

Level playing field	Cost efficiency	Transparency	complexity
• This methodology is attractive for non-CIPU assets. • For CIPU assets, it is not yet clear how the divisibility/indivisibility of the bids (linked to the fixed costs) can be handled.	• Start-up costs are offered **12 blocks * 2 CCGTs per day: → Potential cost increase of 62,3M€ (from 5,7M€ to 68M€)** • **Must-run costs are offered for the up and down part → Potential cost increase of 11,6 M€ (from 11,6M€ to 23,2M€)** • Potential cost increase could be diminished due toe increased competition.	• Transparent price formation in case of fully divisible bids • Not clear what the impact on the transparency would be in case of partly divisible/indivisible bids.	• Algorithm complexity is low • Implementation effort is low

Total cost optimization with a combination of 24-hour and 4-hour blocks

- **The key principles for the capacity tender:**
  1. Combinations of 4-hour blocks and 24-hour blocks
  2. 24-hour blocks are obliged to bid also 4-hour blocks
  3. A total cost optimization for together aFRR up and aFRR down on a daily basis for the aFRR up and aFRR down direction.

- **The following bidding principles shall be applicable:**
  1. Bids are offered in €/MW/h
  2. Maximum step size of 10MW
  3. Obligation to split up large symmetrical bids into smaller symmetrical and asymmetrical bids
  4. Total cost rule will be applicable for all bids.
  5. A dependency between the total cost rule for 24-hour bids and the associated 4-hour bids will be implemented.
  6. A dependency between the total cost rule for symmetric and asymmetric bids will be introduced.

Level playing field	Cost efficiency	Transparency	Complexity
• Risk that only 24-hour blocks will be selected not feasible for non-CIPU. • Feasible for CIPU assets	• Since mainly 24-hour blocks will be selected, there is **no cost increase** with respect to the daily tender • No impact on the must-run costs	Risk that bids with a price below the average price of the selected bids are not selected	• Algorithm complexity is high due the combination of 24-hour and 4-hour blocks. • High implementation efforts

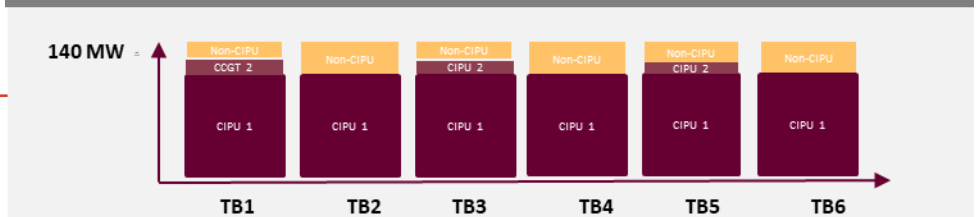
Total cost optimization with 6 blocks of 4-hours where the start-up costs are offered separately

- **Bidding methodology:**
  - Allow only 4-hour blocks (6 blocks of 4 hours)
  - Variable cost in €/MW/h
  - Fixed cost (start-up cost) in € is added separately
  - Total cost optimization per block of 4 hour.

- **Selection of the offers**
  1. The block in the peak-hours where non-CIPU is available (e.g. block 3&4) will be cleared first. For this block, the cheapest reserved volume will be selected based on a total cost optimization. The fixed cost is taken into account in the total cost optimization.
  2. In the next step, the adjacent block will be selected with the largest flexibility. In case an aFRR supplier is selected for adjacent blocks, **the fixed costs will not be taken into account for the adjacent blocks.**

Level playing field	Cost efficiency	Transparency	Complexity
• technically, it is possible to offer bids and Non-CIPU assets can benefit from increased aFRR prices when CIPU do not apply a flat bidding curve • Attractive for CIPU assets	• Limited cost increase since the start-up costs for adjacent blocks will not be taken into account. Worst case scenario gives **4 start-ups per day** → **Potential cost increase of 5,7M€ (from 5,7M€ to 11,4M€)** • No impact on the must-run costs	• Risk that bids with a price below the average price of the selected bids are not selected • The separation of start-up cost makes the price formation harder to grasp	• The algorithm complexity is medium since the optimization problem needs to take into account dependency between blocks • Implementation effort is medium

Illustration worst-case scenario



Summary

- The aFRR capacity tender is still a work in progress
- Elia has put already a lot of effort in investigating different methodologies. However, each methodology has his advantages and disadvantages and Elia did not (yet) found the ideal solution.
- For Elia, the option with the total cost optimization with 6 blocks of 4-hours where the start-up costs are offered separately is the best compromise up so far considering in balanced way the 4 principles.
- Until end June Elia will keep on investigating alternative solutions. Input from stakeholders on this subject - considering the 4 important principles – is welcome

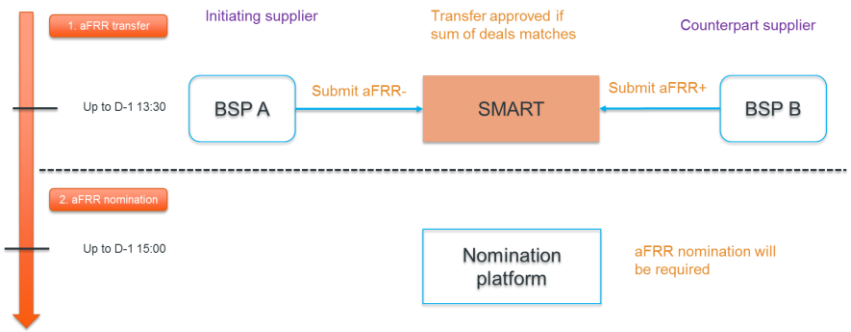
Secondary market

Secondary market

Objective: allow BSPs to bilaterally exchange reserve obligations

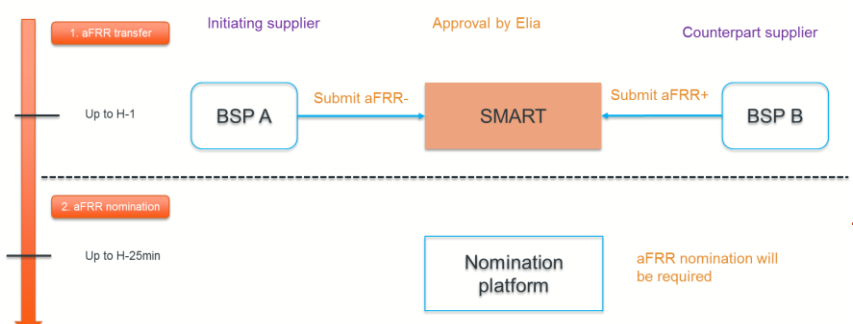
Initial design

Before D-1 13h30



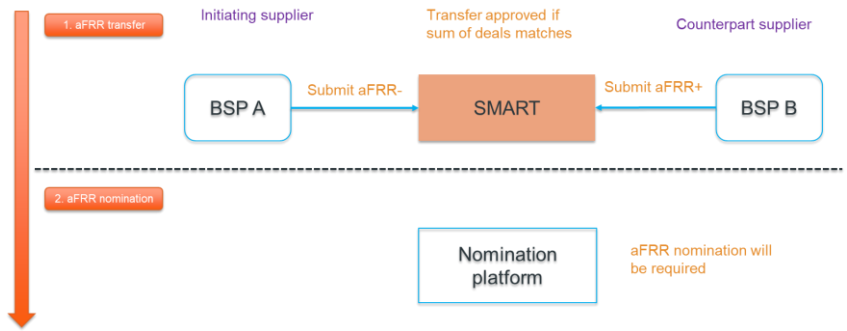
Intraday (H-1)

Not allowed in case of congestion



Proposed design

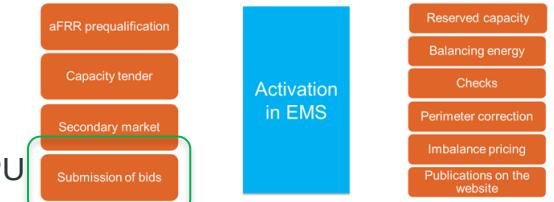
New



- No nomination reserve transfer
- Only obligation reserve transfer
- Up to 1 hour before the start of concerned quarter-hour
- Responsibility of BSP to check if the transfer is possible in the framework of the red zones.

Bidding process for balancing bids

General principles of a bid



- **Principle 1: Unit based versus pool based bidding**
  - The balancing energy bids should be per delivery point for delivery points with an MW schedule (CIPU
  - For delivery points without MW schedule (non-CIPU assets) portfolio bids are allowed.

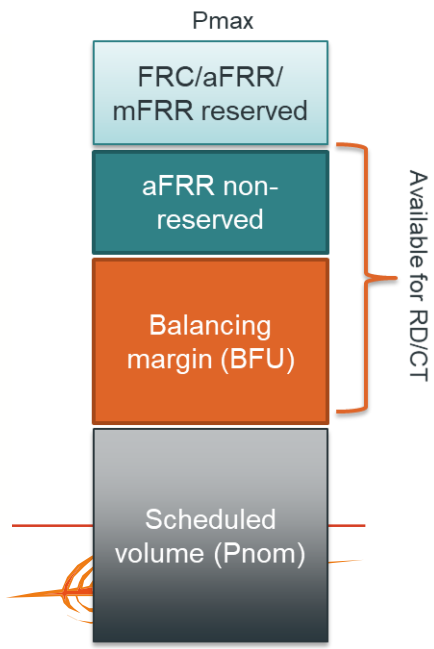
- **Principle 2: Exclusivity of the delivery points**

  A delivery point can only belong to one bid.

- **Principle 3: Continuous bids**

  A bid has a continuous duration. The previous control request of the bid will be the starting point for the next quarter-hour if the bid volume did not change over the quarter-hours.

- **Principle 4: calculation free margin (for CIPU assets)** New
  - General principle:
    The volumes of the bids submitted to the bidding platform will be used for the calculation of the free margin for the upward or downward direction. This calculation can also be performed before the balancing energy gate closure time. In that case, Elia will take the information of the bidding platform which is on that moment available for the calculation of the free margin. Therefore, Elia asks that the bids offered in the bidding platform are on a **best effort basis**, also before the balancing energy gate closure time in order to have the most accurate calculation of the free margin.
  - For the calculation of the free margin for balancing, aFRR non-reserved and aFRR reserved is not part of this available margin.
  - For the calculation of the free margin for redispatching/countertrading bids, the aFRR non-reserved is part of the available margin.



Timings for submission of the balancing energy bids

- **Pre-offering for reserved bids: <u>D-1 @ 15h00</u>**

- **Balancing energy gate closure time for all bids: <u>QH-25min</u>**
  - Add more volume than the aFRR obligations
  - Do a transfer between reserved and non reserved bids within his portfolio
  - Update of reserved bid (volume increase/decrease) and activation price
  - Taking into account the red zones

Maximum activation price for reserved bids

- Initially, Elia has proposed an ex-ante determined price cap for the reserved bids.

New

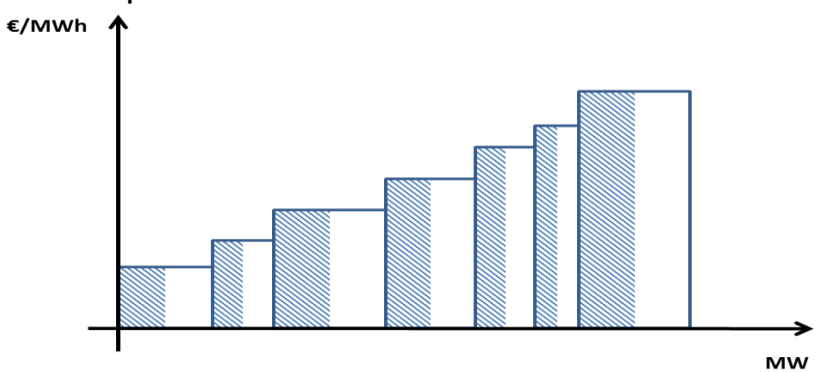
- Since Elia will propose an average weighted pricing based on the activated bids for the imbalance tariffs as a transitory measure, Elia is of the opinion that the price cap is no longer needed.

Activation in EMS

Merit order versus pro-rata activation

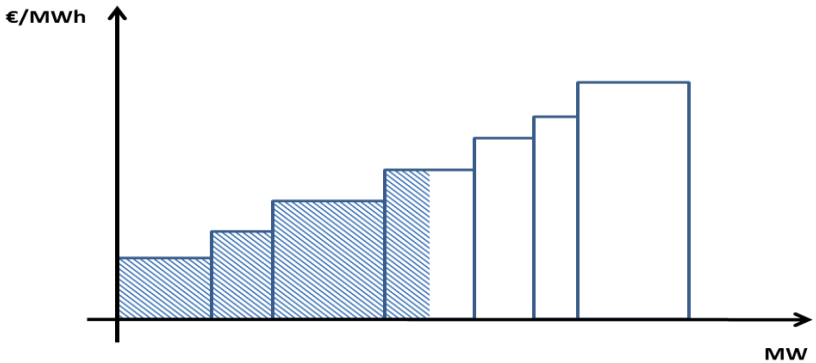
Activated aFRR bids

pro-rata aFRR



- Pro-rata activation:
  - All bids are continue activated

merit order aFRR



- Merit order activation:
  - X cheapest bids are activated

Activation process

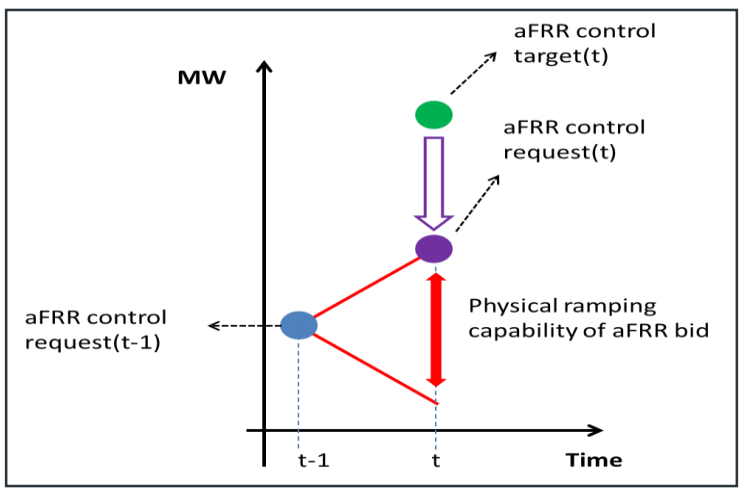
aFRR prequalification
Capacity tender
Secondary market
Submission of bids
Activation in EMS
Reserved capacity
Balancing energy
Checks
Perimeter correction
Imbalance pricing
Publications on the website

BSP A
BSP B
BSP A
BSP B

aFRR control target per bid (4")
aFRR control request per bid (4")
aFRR control request per BSP (4")

ACE
PI-controller
Respect ramp rate of aFRR bid
∑
BSPs

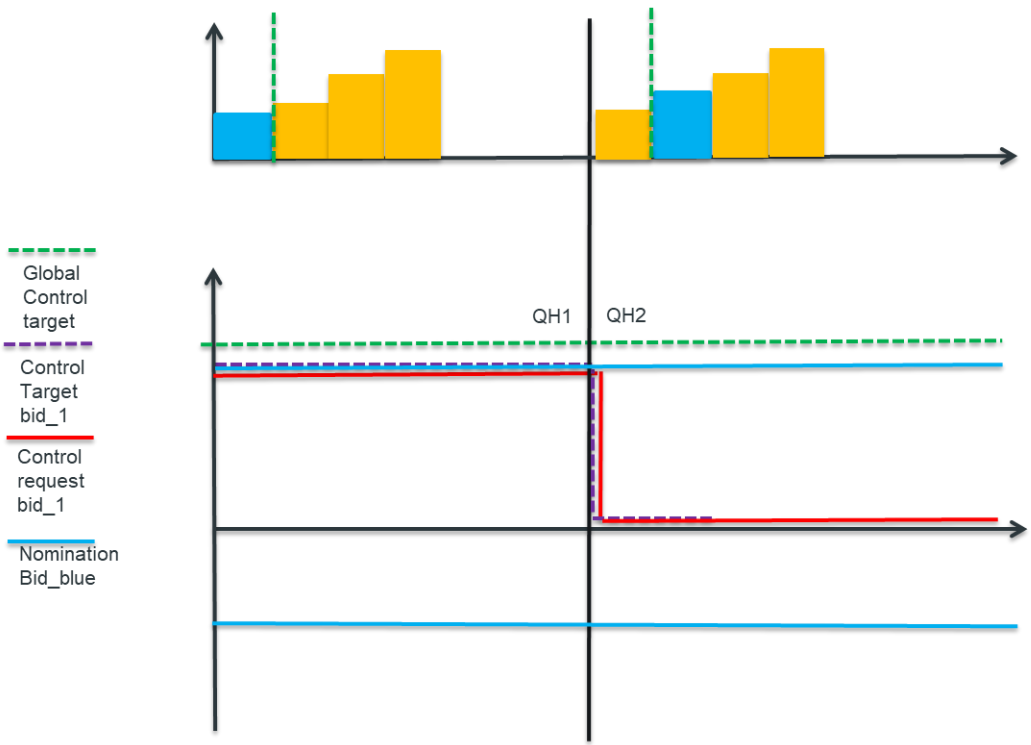
BSP A
BSP B



∑ = 1 setpoint

New

Change of ranking of bids between quarter-hours



- The ranking of the bids within the MOL can change each quarter-hour
- If a bid is activated at the end of Qh1 and no longer activated at the start of Q2 due to a change of the ranking of the MOL (blue bid in the graph), the control request goes directly to zero.
- This rule is only applicable for the transition between two quarter-hours. Within the quarter-hour, the normal ramping rate will be applied.

Control and settlement of reserved capacity

Control and settlement of reserved capacity

- Remuneration Monthly basis
  - The remuneration is the product of:
    - The unit price, in €/MW/h;
    - The number of MW of R2
  - The upward and downward Missing MW are not remunerated.

Control and settlement of balancing energy

Control and settlement of balancing energy

The settlement:

- The settlement is performed on a monthly basis.
- The settlement is based on 4 seconds data
- The settlement is based on the requested energy.
- A pay-as-bid settlement

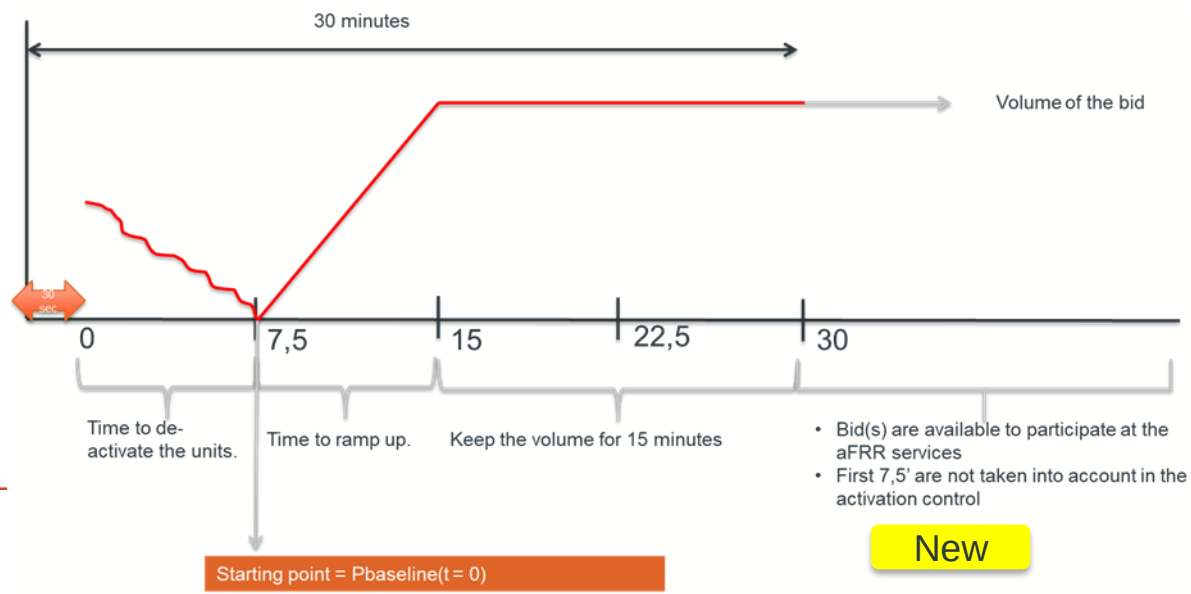
Availability check

Availability check

- Goal: to check whether the reserved volume of a bid is available for activation

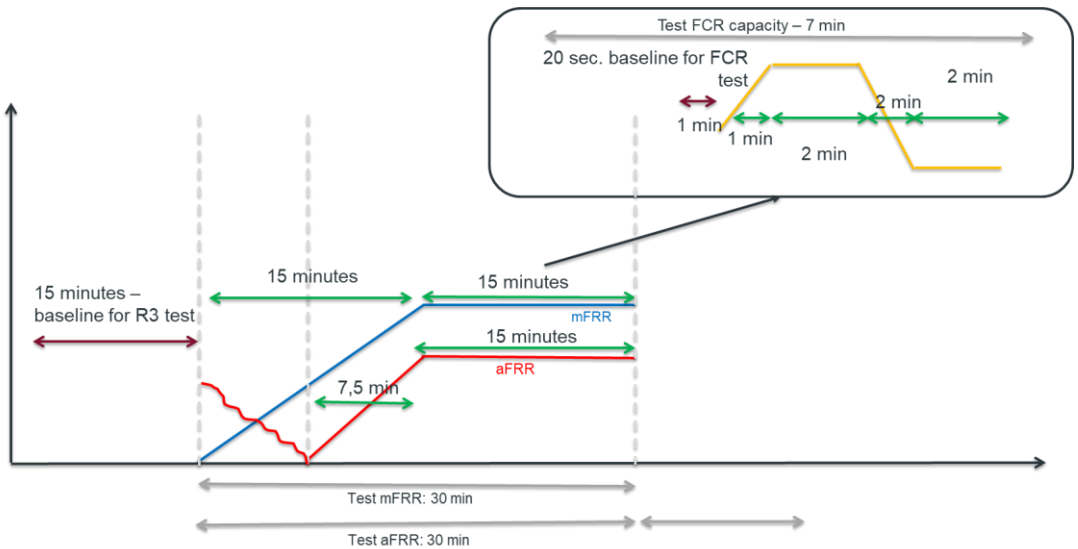
- Principles:
  - Elia will always activate 100% of the volume of the reserved bid
  - Elia has the right to test more than one bid simultaneously
  - Elia will only consider the delivery point(s) attributed to the concerned bid(s) for the verification of the test
  - The test will not be remunerated
  - The test will only be performed in one direction
  - The test profiles are known ex-ante.

- The test is triggered by an XML signal **New**



Combined availability test

New



- The same profiles as for the individual availability tests will be foreseen
- Test will be launched for each product individual

Imbalance tariffs

Imbalance tariffs

- The ***marginal price for upward regulation*** is, for a given quarter-hour, the highest unit price of all upward activations ordered by Elia for maintaining the balance in the Belgian LFC Block.

  It corresponds to the maximum of the respective marginal prices of the various up-settlement resources that Elia activated. These resources may be:

  - Energy imports through IGCC grids
  - Secondary reserves
  - Incremental bids
  - Tertiary reserve

- The ***marginal price for downward regulation*** is, for a given quarter-hour, the lowest price of all downward activations ordered by Elia for maintaining the balance in the Belgian LFC Block.

  It corresponds to the maximum of the respective marginal prices of the various up-settlement resources that Elia activated. These resources may be:

  - Energy exports through IGCC grids
  - Secondary reserves
  - Decremental bids

The price for upward (downward) regulation of secondary reserves is the **weighted average price of all upwards (downwards) activated volumes** during the concerned quarter-hour. New

General conclusions and next steps

General conclusions

Design study:
Opening of the aFRR market to all technologies

Important changes:
- A daily separated procurement for aFRR;
- A separated procurement for FCR and aFRR;
- Balancing energy gate closure time for submission of aFRR energy bids close to real-time;
- Allowing portfolio energy bids;
- A merit order activation.

Next steps

- Elia will work further on the methodologies for the aFRR capacity tender
- Any feedback on the methodologies presented today is very welcome
- Elia will come back when more information is available on the aFRR capacity methodology (by the end of June). Elia will also provide by then an updated design note.