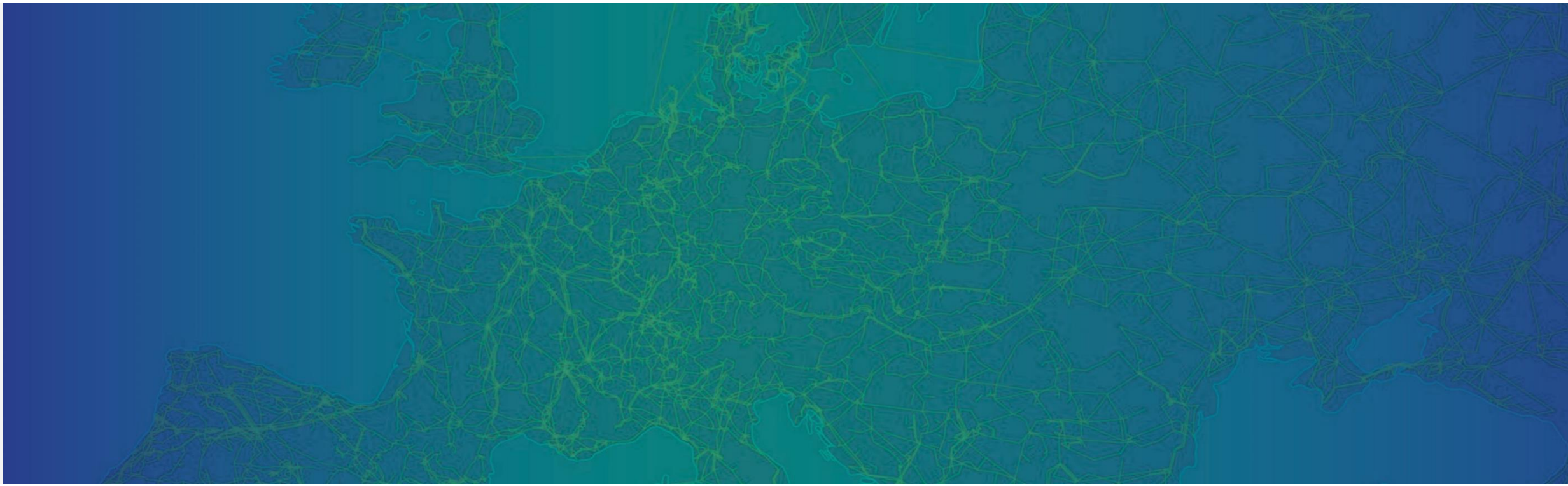
Workshop on the mitigation measures against Long Lasting Extraordinary Frequency Deviations

Brussels, 8th May 2024



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Mitigation measures against LLEFD

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Mitigation measures against LLEFD

Framework and scope

According to Art.156(10) SO GL, TSOs shall develop a common proposal concerning the minimum activation period to be ensured by FCR LER during alert state (TminLER).

The proposal shall take full account of the results of the CBA conducted pursuant to Article 156(11) of SOGL. The proposal is subject to NRAs' approval.

Timeline:

- *October 2021: NRAs approve the CBA methodology proposed by TSOs.*
- *December 2021: TSOs submitted their first proposal for a TminLER.*
- *December 2022: NRAs issued a **Request for Amendment** on TSOs' proposal.*

- CE NRAs request TSOs to **run a new instance of the CBA** methodology after **having updated some of the key input** regarding frequency and FCR costs.
- A **focus is on Long-Lasting Extreme Frequency Deviations events** (LLEFD), that are events with frequency constantly differing from 50Hz for long periods (>>15 min). LLEFDs could have a great impact on CBA results.
- TSOs performed a **root-causes analysis of 20 most impacting LLEFDs in 2017-2021**.
- NRAs request TSOs to assess the performances of the FRP and to **present the measures TSOs are adopting to improve frequency quality by reducing the impact of LLEFDs**.

Mitigation measures against LLEFD

Framework and scope

This presentation is aimed at presenting the results of the investigation on current and planned mitigation measures against LLEFDs:

- A forward-looking approach is adopted: the **focus is on TSOs' efforts in improving the effectiveness of LFC Scheme**, rather than on retrospective analyses.
- An effective way to reduce LLEFDs impact (occurrence, amplitude and duration) is to improve the coordination between TSOs allowing an **effective and prompt cross-border activation of FRR to deal with the extraordinary conditions associated with LLEFDs**.
- Both **structural and operational** measures are considered.
- The measures are divided into two categories:
  - Common to all TSOs (applicable at SA level)
  - TSO-specific

The analysis performed on 20 most relevant LLEFDs in 2017-2021 show that the root-causes can be mostly traced back to multiple, unforeseeable combinations of extraordinary events/conditions .

Each TSO involved in at least one of the 20 most relevant LLEFDs present its specific structural/operational countermeasures.

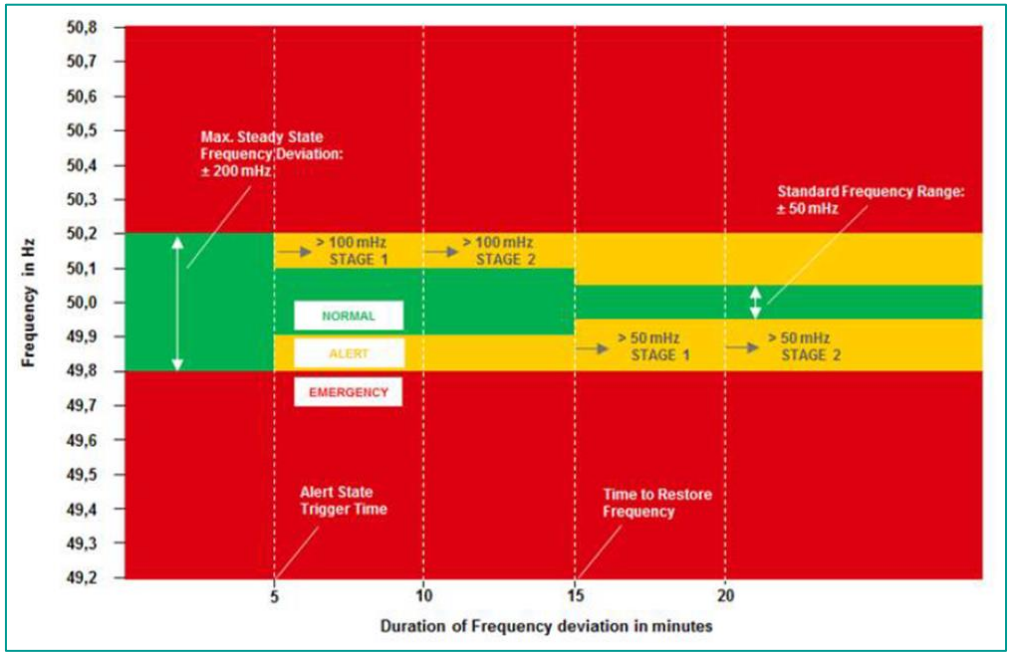
Operational mitigation measures at SA level

Extraordinary procedure in case of alert state

According to Art.118(1)(n) **TSOs shall jointly develop operational procedures to reduce the system frequency deviation**, to restore the system state to normal state and to limit the risk of entering into the emergency state.

As part of this effort, **TSOs are constantly keeping updated the extraordinary procedure in case of alert state** due to a violation of system frequency limits (B-9 of Synchronous Area Framework Agreement, SAFA).

The procedures defines the **rules for triggering different alert conditions** (stages 1, 2) and **identify roles and responsibility** of all involved parties (TSOs, Coordination centers) with the **specific communications which shall take place** amongst them.



Stage1 and Stage 2 triggering conditions

For LLEFDs, **a TSOs experiencing a long-lasting imbalance** (not expected to be compensated in the foreseeable future), **or any TSO that has serious concerns regarding its own system due to the LLEFD, has the right to ask for a manual trigger alert state conditions** at any time by contacting the responsible Coordination Centre.

The **Coordination Centre** then decide to **initiate the predefined actions** associated with Stage 1 or Stage 2.

TSOs specific mitigation actions

Transnet BW, TenneT, Amprion, 50Hertz (Germany)

German Block were involved in LLEFDs with conditions where market incentives for balanced BRPs were no longer effective. In these situations, intraday prices significantly exceed the imbalance prices, thus leading to a reduced incentives to remain balanced.

To mitigate such conditions, **several market related measures were taken to increase the incentive for the market parties in being balanced** and to support in such situations:

- to connect the Imbalance Settlement Price (ISP) to the intraday market price;
- to allow unlimited exponential increase of the scarcity component in imbalance settlement (resulting in an ISP always higher than the intraday market price).

On the operational side, a publicly available traffic light ("NRV-Ampel") has been introduced to **make the market aware of an extremely short or long position of the German LFC block** quite close to real time (2 minutes delay). The traffic lights are also linked to the scarcity component in imbalance settlement.

German TSOs have also implemented a **publication of an estimation of the ISP of the previous quarter-hour** (based on operational data). This estimation inform market parties about the expected ISP, thus **providing close to real-time information and incentives to be balanced**.

TSOs specific mitigation actions

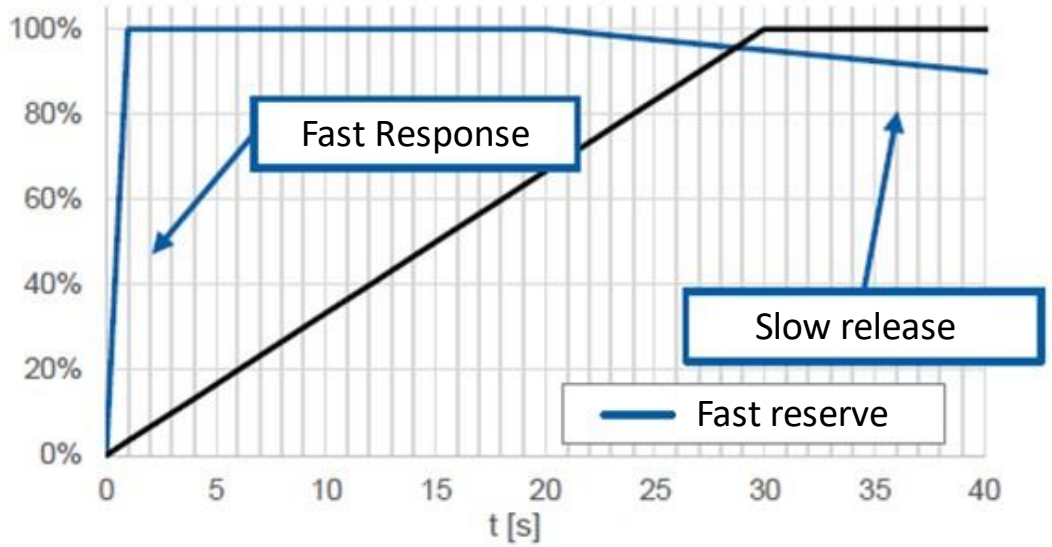
TERNA (Italy) (1/2)

As **structural measures planned to increase the availability of reserves**, TERNA has also put in place rules and projects to **increase the use of Battery Energy Storage Systems (BESS) for grid support**. 2 GW of BESS is expected to come into operation by the end of 2024.

Specifically related to fast frequency regulation, the so-called Fast Reserve service is being developed through a pilot project, which foresee the participation of BESS for a total amount of ca. 250 MW in the whole Italian power grid.

The BESSs participating in the project, ranging from 5 to 25 MW, provide **ultra-fast response** to frequency deviations to support the activation of the frequency containment reserve.
This contribution must be guaranteed for at least **15 minutes** at nominal power and helps mitigate frequency deviations, giving time for other services deputed to restore frequency to act according to their activation times.

The Fast Reserve service is foreseen to be structured within the Italian Network Code by 2025.



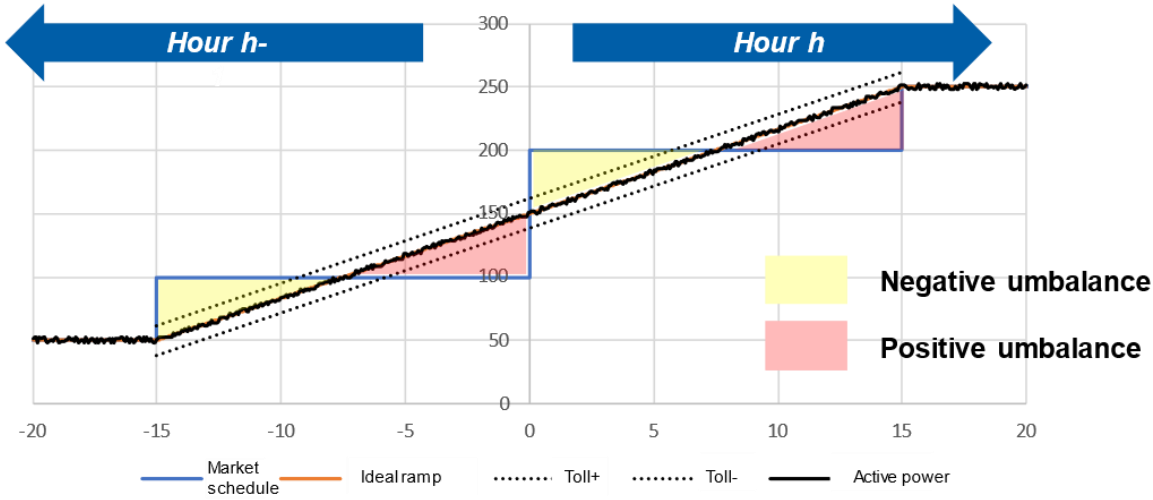
TSOs specific mitigation actions

TERNA (Italy) (2/2)

In an event, fast imbalances around the change of market time units (MTUs) have been a contributing factor in triggering a LLEFD.

To structurally mitigate those events, the **Italian Network Code was updated to include requirements on ramp connection** profile between consecutive hourly power schedules. This requirement allows to reduce the unbalance cause by active power variations, thanks to a smooth transition between the power schedule of different MTUs.

Currently, the ramping requirement is applied to thermal generation units, and will be soon extended to hydro generation units.



Terna has also put in place an initiative, called “Eco-Clock ” **to raise consumer awareness of conscious energy use through a system clock that indicates when it is most convenient to consume energy**, both from a security and economic point of view.

TSOs specific mitigation actions

REE (Spain)

The root-cause of LLEFDs is often variability of RES, inaccuracy of schedules or lack of downward reserves.

In Spain **RES participate in a major extent in the balancing processes** (21 GW PV/Wind qualified in RR and mFRR + 4 GW in aFRR).

The current market structure and market platform, and the **REE control center for renewable energies (CECRE)** allow for such integration in the market processes and for steering renewable generation. CECRE **can send orders to control renewable production in case operational security limits are violated**.

Both observability (≥1MW) and **controllability** (≥5MW) **of renewables enhance the balance of the system minimizing generation surpluses** which cannot be integrated into the system.

The prequalification of RES aFRR providers is being increased in order to improve aFRR activation against imbalances.

Such operational measures **help in dealing with conditions with high RES production** that could contribute to scarcity in downward reserves.

TSOs specific mitigation actions

IPTO (Greece)

Greece has been involved in a LLEFD during which a significant lack of operational reserve was experienced due to extreme weather conditions:

- Due to the adverse weather both wind and PV were unavailable.
- extremely low temperatures significantly impacted the lignite power production, in the context of gas supply limitation affecting the country for several weeks.
- GR-IT HVDC link was out of operation.

To mitigate the possibility for a similar event to reoccur, several structural measures have been put in place:

- **Liquefied Natural Gas supply** has been **increased**.
- Development of a **National Risk Preparedness Plan**.
- **Increasing emergency energy limits with neighboring TSOs** (Operational Agreements have been reviewed).
- **New thermal units** have been **committed** (with further ones expected to be commissioned shortly).

As countermeasures against shortages of downward reserve, following measures are in place/planned:

- **RES production limitation and use of hydro pumping plants**.
- **Demand Response and Dispatchable RES** have come in service
- **Join IGCC platform** (March 2023)
- Campaign to inform consumers when is more convenient to consume energy

- Use of BESS for grid support (under public consultation)
- **Development of a RES control platform to improve the management of renewable production** (planned)

TSOs specific mitigation actions

Transelectrica (Romania)

Romania was involved in a LLEFD during which a very sudden increase in wind production occurred (over 500 MW) while several thermal generator units were stopped. The event was managed by reducing the power produced by the wind plants.

To deal with similar conditions in the future, several operational measures are already in place:

- **Improvement in EMS-SCADA system to enhance observability of the system** (e.g., including available power, radiance, wind speed/direction)
- Introduction of **active power control for category B plants**.
- Introduction of **tests on frequency response for RES**.
- Monitoring of frequency at the ends of interconnection power lines.

As structural measure, BESS requirements for connection was introduced, **including qualification procedures for providing ancillary services**.

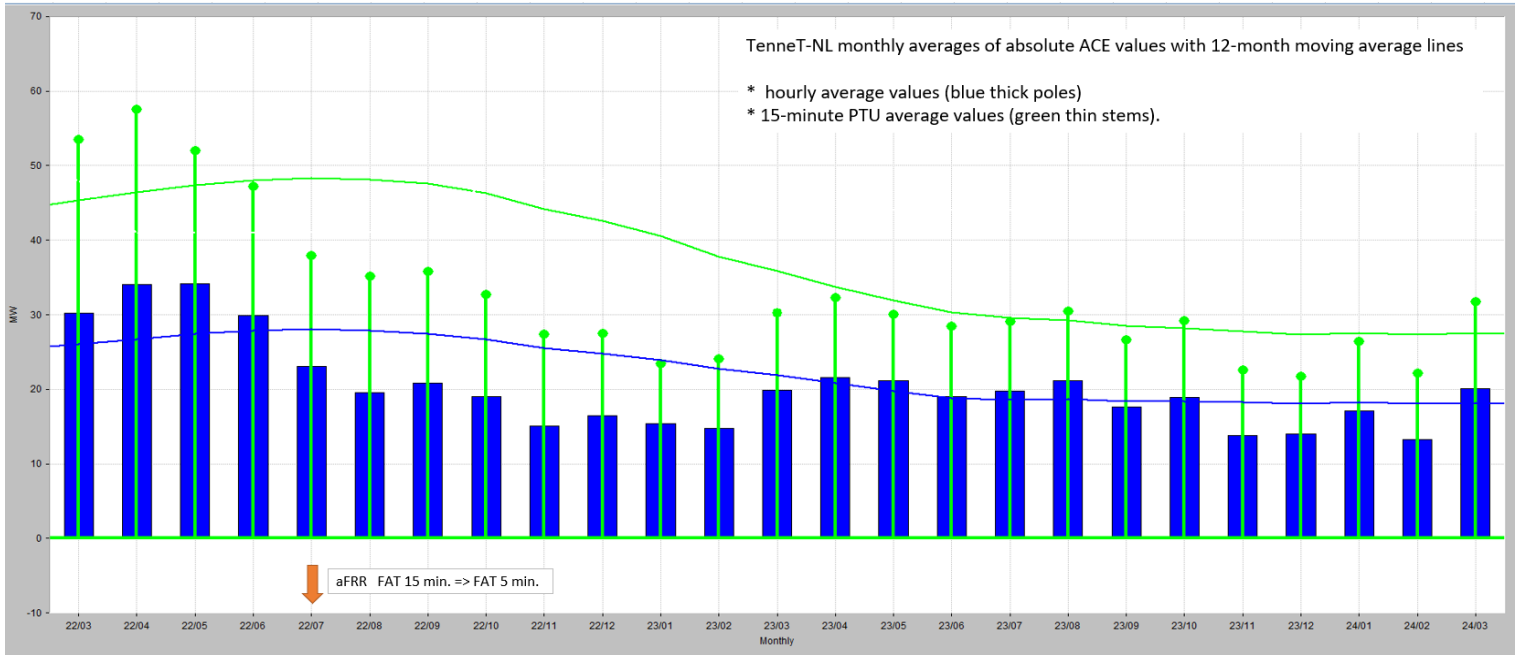
Finally, a **review of AGC** is planned.

TSOs specific mitigation actions

TenneT (The Netherlands)

The Netherlands was involved in LLEFDs where a contributing factor was a relatively slow activation of aFRR.
The contribution of TenneT NL couldn´t be controlled to zero within the foreseen time to restore frequency of 15 min.

As a countermeasure and in accordance with the obligation of a harmonization of the Full Activation Time (FAT) for aFRR in Europe, the FAT **has been changed from 15 minutes to 5 minutes** (1st July 2022).



This change also required changes in the local Terms and Conditions towards the BSP, as they have also to follow the new FAT.

Due to the change in FAT,
ACE quality of TenneT NL has improved.

TSOs specific mitigation actions

ESO (Bulgaria) (1/2)

Bulgaria was involved in a LLEFD due to low load condition with limited supply of downward reserve, possibly with high renewable generation.

For such cases, several structural measures are in place:

- Introduction **intraday market**.
- Introduction of a **15 min Imbalance Settlement Price**.

Other structural mitigation measures are planned:

- **Changes in balancing price** rules will be introduced.
- **New technologies for balancing** will be allowed.

TSOs specific mitigation actions

ESO (Bulgaria) (2/2)

The precise definition of the market model for balancing mechanism, including prices for balancing energy and prices for imbalances, is crucial for the successful balancing of the control area. Price caps need to be removed to make the right market signals to investors in balancing technologies on the one hand and to discipline market participants to respect their trading schedules on the other.

During and after the energy transition, renewables and new storage systems will play a significant role as BSP of FRR replacing gradual phase out of lignite fleet.

Reserve sharing is essential for dispatching control, therefore further cooperation to reach this goal with neighbouring TSOs is needed.

Ongoing activities:

1. Two units in PSHPP Chaira (210 MW generation / 180 MW pump per unit) are expected to be in operation in late 2024 or early 2025.

2. Installment of BESS is expected to start by the end of 2024 by the support schemas of NRRP.

3. Market changes are expected till the middle of 2024, including: negative price introduction for balancing energy; removing the cap for balancing energy prices; and improvement of imbalance prices settlement.

4. In line with energy transition ESO prequalified RES (PV 300 MW and Wind 70 MW) as mFRR providers, basically for downward balancing. Prequalification of RES for aFRR provision is expected by the end of 2024.

5. Preliminary discussion for reserve sizing and sharing started with neighboring TSOs of RCC Selene CC.

TSOs specific mitigation actions

ELIA (Belgium)

Belgium was involved in LLEFDs related to low load conditions with limited supply of downward.

To mitigates the effects of similar conditions in the future, several improvements are planned:

- A **revision of price incentives provided as signals to market** parties.
- **Connection to MARI/PICASSO** will provide additional flexibility in reserve activation.
- An **imbalance forecasting tool** is under development **to provide additional information** to the engineers in service.

Furthermore, **improvements of operational procedures and activation criteria** have been already implemented.

TSOs specific mitigation actions

EMS (Serbia)

EMS provides further explanation of its involvement in some of the LLEFDs (events #1, #5, and #6).

Territory of Kosovo and Metohija was part of EMS control area.
They were unbalanced for a long time period (usually short, but in these specific cases, they had surplus) and not willing to cover the costs of EMS for balancing energy.

The amount of renewables currently installed in the Serbian territory is not high and power generation is mainly through conventional plants. From the point of view of reserve management and frequency regulation, therefore, the typical problems associated with high renewable penetration conditions are not experienced.

Final remarks

Final remarks from NRAs representative

Closing the 8th May workshop, NRAs' representative provided some final remarks regarding the LLEFD issues:

- TSOs analyses shows that key causes of LLEFD are conditions with a lack of procurable reserve (mainly downward, at low load condition with high renewable production).

- The energy transition will involve an ever-greater share of wind and solar in the energy mix. As such, TSOs could not rely anymore only on spinning technologies to deal with the issue.

- TSOs should consider further strategies to increase the availability of reserves:
  - Enhance the provision of reserves from small and aggregated units;
  - Enhance the possibilities for load to participate in ancillary services;

- Furthermore, the TSOs should have the possibility to curtail RES to cope with conditions with extreme low load/high RES, since the possibility of negative balancing prices are effective signals to BSPs, but the timeframe in which they lead to RES reduction may pose a problem in the real time operation.

Backup

Schedule of activities in 2023-2024