EU-SysFlex

German Demo:

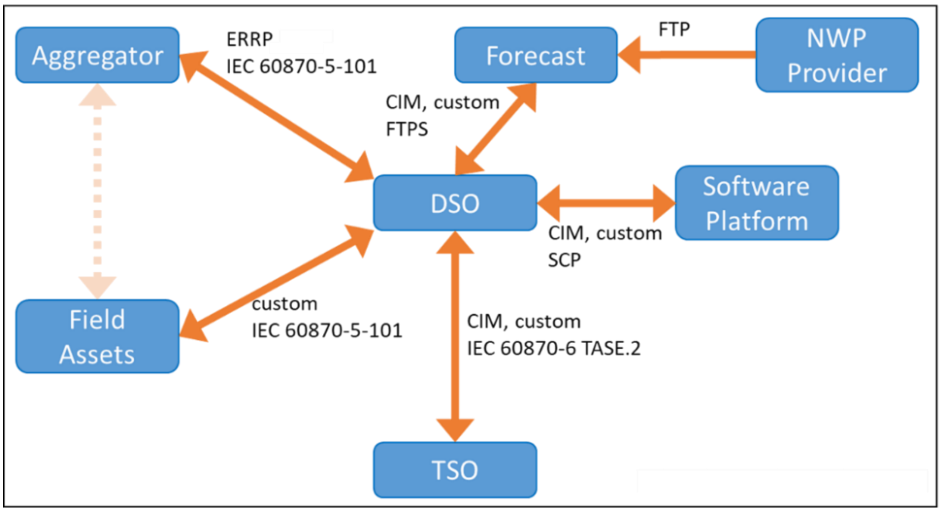
Flexibility from distribution grids for active and reactive power provision

The aim of the German Demonstrator was to enable the provision of flexibility services from DSO connected sources to the TSO, for TSO congestion management due to line loadings and voltage limit violations. In addition, the DSO itself uses the same services in order to sustain stable and reliable grid operation in the distribution grid. For these flexibility services, active and reactive power provision from assets in the distribution grid are managed. Primarily, conventional, as well as RES generation, units in the high voltage (HV) grid, in Germany, namely 110 kV, will provide these flexibility services. For active power flexibilities, assets not directly connected to the HV grid but rather connected to lower voltage levels can also be utilised. Flexibilities are not prioritised according to voltage level, but rather according to sensitivities on congestion and costs. The German Demonstrator took place in a distribution grid with a RES share that significantly exceeded the total local consumption.

Key Features

- Integrates new and improved forecast for RES-E generation and load
- Schedule based co-optimising for congestion management and voltage control
- Includes RES-E in schedule based congestion management and reactive power management coordinated between TSO and DSO
- Transforms optimisation results into control signals within automated processing for reactive power management
- Enhances grid efficiency in distribution grid.

Implementation approach



This simplified communication model of the German Demonstrator shows the DSO-centric approach in utilising flexibilities in the distribution grid for the transmission grid without jeopardising grid stability in distribution grid. As an additional benefit, this approach supports high resiliency of grid operation. Despite the demonstrator's regulated environment, it is applicable to market-based flexibility procurement, as the flexibility optimization approach is independent from the market design approach.

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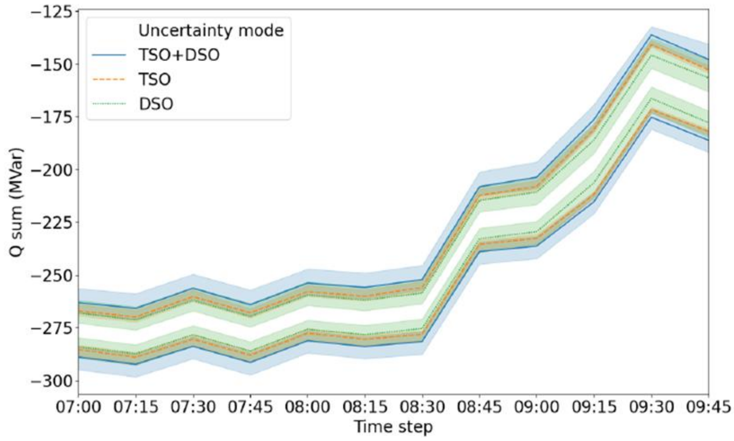
The accuracy of calculations and optimisation depends on several factors. As seen in the following graph, the TSO influences the distribution grid, and, therefore, data from the TSO need to be considered in calculating the limits of available flexibility provision. The German demonstration showed that these uncertainties are higher for reactive power management compared to active power management. Due to high forecast uncertainty, the resulting impact on uncertainty for schedule-based procurement of flexibilities is even higher.



Key Achievements

- Improved schedule-based congestion management and voltage control for DSO
- Definition of DSO-TSO coordination process to enhance utilisation of flexibility for TSO for congestion management and voltage control
- New function of automation of coordinated TSO/DSO voltage control management
- Improved accuracy of RES feed-in forecast by 5% and for load by 8%
- Reduction of grid losses by 5%

Findings

The German demonstrator developed and proved a schedule-based active and reactive power management process, including RES from distribution grids, which improves the volume and diversity of flexibility products/resources in the TSO portfolio. This demonstration also provided practical evidence for successful coordinated TSO/DSO congestion management and voltage control. The developed tool for voltage control allowed the DSO to improve efficiency in grid operation. Additionally, the tool disencumbers operational staff from complexity by providing predicted optimised grid states and proposing the needed set points of flexibility to achieve these optimised grid states in the distribution grid. The most efficient use of flexibilities can only be achieved by considering active and reactive power management at the same time.

In combining predicted optimised congestion-free grid states in the distribution grid for the DSO, and available flexibility range for the TSO, the processes and tools of the German demonstration contributed to a reliable, safe and secure energy system with a high-RES share.

Recommendations and Lessons

An efficient and effective TSO-DSO coordination process should be based on the following principles:

- Every system operator is responsible for its own grid.
- Every system operator predicts the available flexibility potential in its own grid.
- System operators from connected grids are informed about available flexibility potential.
- Flexibility selection and activation is carried out by the system operator where the flexibility is connected.
- Both TSO and DSO needs, and constraints are taken into account.

Data management principle, “data thrift”, followed by the German demonstrator proved its feasibility, and is based on the following aspects:

- Grid data always stays in the sphere of the respective system operator.
- Grid impact analysis remains the responsibility of the respective system operator.
- Data exchange is aggregated as much as possible to reduce complexity.

The decentralized optimization approach followed by the German demonstrator has proven to be highly resilient, efficient and secure as it follows the optimization principle “local before regional”.

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