INTERPLAN

INTEgrated opeRation PLANning tool towards the pan-European network

Transforming Grid Operation Planning

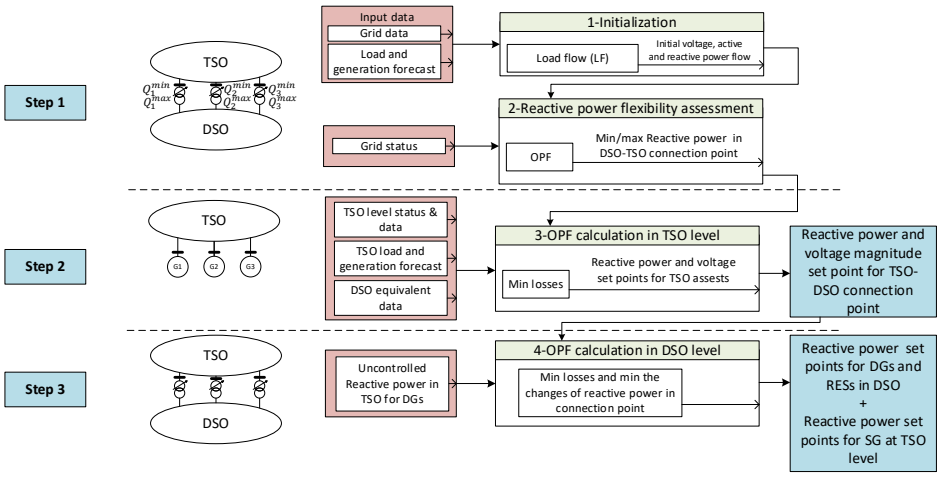
Use Case 1: Coordinated voltage/reactive power control

Objective: Minimizing the deviation from voltage and reactive power set points at TSO-DSO interface as well as minimizing grid losses in both levels.

Network operation planning criteria: Minimising the losses, maximizing the share of RES, assuring voltage stability, optimizing the TSO-DSO interaction, maximizing the DRES/ DG contribution to ancillary services.

Use case solution: Optimized planning (for the next 24 hours) of reactive power distribution at both transmission and distribution levels with a focus on TSO-DSO interface regarding reactive power set points at the connection points provided by the TSO as well as the minimization of grid losses in both levels.

Context diagram:



Description:

Step 1: After performing an initial power flow, a minimum and maximum reactive power flexibility assessment is performed to calculate the resulting flexibilities for the DSO at the TSO-DSO connection points using an OPF.

Step 2: Considering the calculated initial values as well as the possible reactive power flexibilities from Step 1, an OPF at TSO level is performed with the subject of loss minimization. Here, equivalent generators represent the DSO level.

Step 3: The DSO calculates the reactive power set points for the controllable units using an OPF to achieve the calculated set points for reactive power at the connection points. In this way, the losses at the DSO level are also minimized.

Operation challenge:

- Voltage stability

Actors:

- TSO
- DSO

Controllable units:

- Synchronous generators
- DRES and DG

Project duration

1 November 2017 - 31 January 2021

Contact

interplan-project.eu

Giorgio Graditi (Project Coordinator)
giorgio.graditi@enea.it

contact@interplan-project.eu

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 773708

Use case developer: Fraunhofer IEE (yannic.harms@iee.fraunhofer.de, lothar.loewer@iee.fraunhofer.de)

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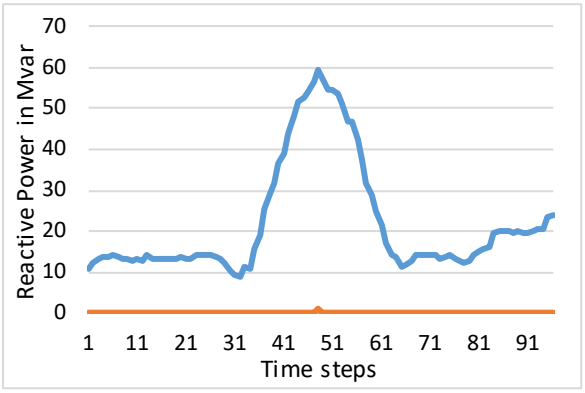
The key results of implementing use case 1 control functions:

Mean quadratic deviation from reactive power targets at TSO and DSO connection points:

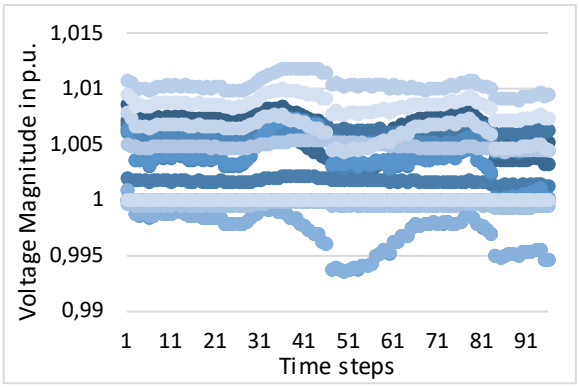
- This diagram presents the mean quadratic deviations from reactive power targets at the TSO and DSO connection points without use case 1 control function (blue curve) and with the presence of control function (orange curve).



- The simulation is performed for the time range for one day with the resolution of 15 Minutes. As the curves show, the mean quadratic deviation regarding the target values for reactive power is close to zero for every time step.

Voltage Quality in TSO and DSO network:

- This diagram presents voltage magnitudes for the 96 different time steps over the busses (represented by the color). Due to the amount of busses in the regarded network, the figure only shows the values for the TSO network.



- The simulation is performed as mentioned above. The values of the voltage magnitudes show that all voltages of the TSO network are within the limits of ± 4-7% of the nominal voltage (according to EN 50160 Standards and VDE-AR-N 4120). Also, the values for the DSO network are within the limits defined there. The values show that the developed and applied control function of UC1 assures the voltage stability in both grids.

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