

Coordinated voltage control of distribution networks including DG

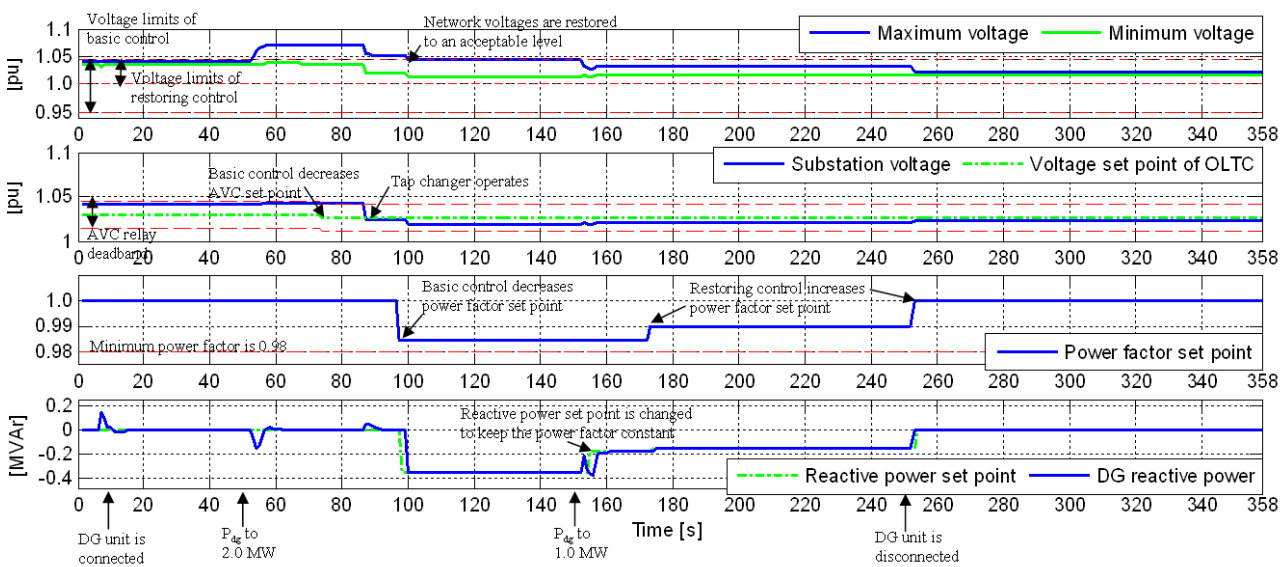
Connections of distributed generation (DG) to weak distribution networks often experience voltage rise problems. The voltage rise can be mitigated using passive methods such as increasing the conductor size but this can be quite expensive. Network maximum voltage can be reduced also using active voltage control methods (e.g. reducing substation voltage) which can in some cases reduce DG connection costs substantially.

COORDINATED VOLTAGE CONTROL

Coordinated voltage control methods use information about the whole distribution network when determining their control actions. Hence, data transfer and state estimation are needed.

The coordinated voltage control algorithm developed in ADINE project controls the substation voltage and the reactive power of DG to keep the network voltages within acceptable limits.

The control algorithm comprises two functions: Basic control is used to restore the network voltages to an acceptable level when voltage rise or drop at some network node becomes excessive. Restoring control restores the DG's power factor set point to unity when the network state allows it and normalizes the voltages when the voltage level of the whole network has remained unusually high or low. (ADINE deliverable 17: Specification of coordinated voltage control application).



The operation of the coordinated voltage control algorithm in an example RTDS simulation. DG reactive power is the primary control variable.

DEMONSTRATIONS

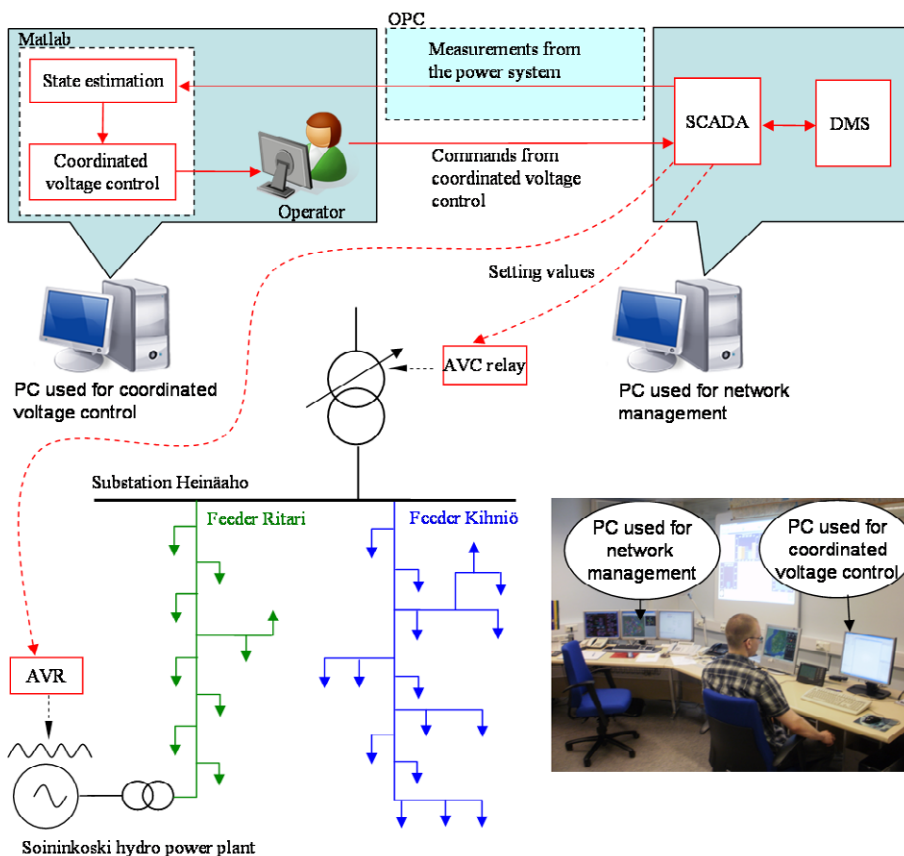
The operation of the centralized voltage control algorithm is demonstrated using Real Time Digital Simulator (RTDS) and also in a real distribution network. The algorithm is implemented as a Matlab program and realizes state estimation, coordinated voltage control and data exchange between Matlab and SCADA.

In the real network demonstration, the control is realized as an advisory tool and the operator approves the suggested control actions before execution. In RTDS simulations, a closed-loop system is used.

CONCLUSIONS

The demonstrations verified the correct operation of the implemented coordinated voltage control algorithm. The algorithm enabled connection of a relatively large hydro power plant to a network where voltage rise problems would be present without the control.

In ADINE project the coordinated voltage control algorithm was implemented as a Matlab program that realized also state estimation. The algorithm could also be implemented as a part of distribution management system (DMS) in which case the state estimator already available in DMS could be used.



The arrangement in the real distribution network demonstration.



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