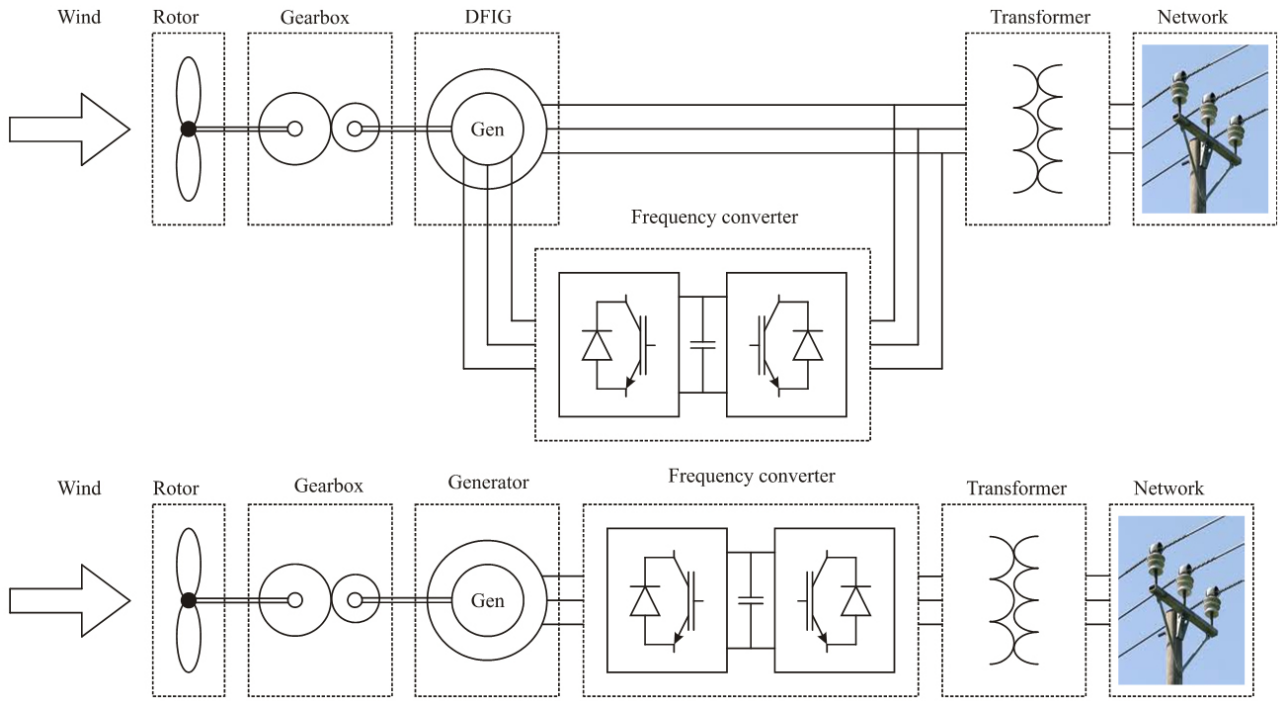
Wind turbine concepts

The penetration of wind generation has increased in many areas to a significant level. In such areas, modern wind turbines are required to be able to endure deep voltage dips. Otherwise, major problems to the power systems stability would occur. In addition to staying connected during the fault, modern wind turbines should be able to support the grid voltage during the voltage dip by injecting reactive power.

Two most common variable speed wind turbine types are the doubly-fed induction generator (DFIG) wind turbine and wind turbine with full-power converter interface to the grid. However, the behavior of the concepts during the grid voltage dip differ significantly. The DFIG suffers from high rotor voltages and currents. Hence, the converter connected to the rotor windings may have to be disconnected in order to protect the converter. Then, the wind turbine is not controllable anymore which complicates the reactive power injection for network voltage support.

The wind turbine with full-power converter is capable to ride through voltage dips. Actually the generator itself does not recognize the voltage dip at all since frequency converter decouple the generator from the grid. In addition, full-power converter concept is also capable to inject reactive power to the network for voltage support purposes.



Doubly-fed induction generator wind turbine concept and full-power converter wind turbine concept.

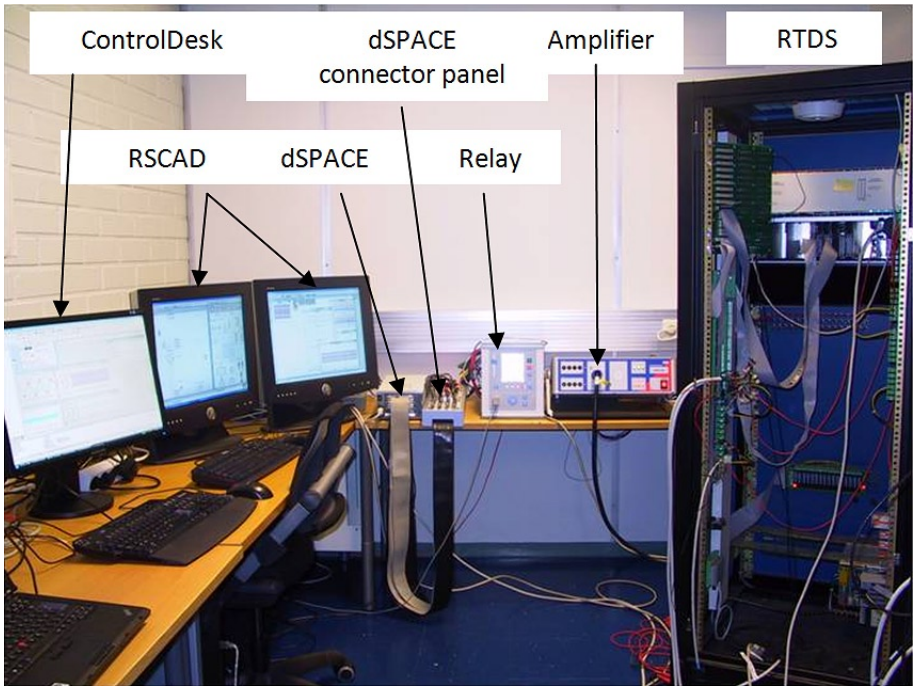
ADINE is a project co-funded by the European Commission

Study environment

The study is done by using novel real-time simulation environment consisting of Real-time Digital Simulator (RTDS), dSPACE and protection relay. The combination of the powerful power system simulator (RTDS) and efficient control system simulator (dSPACE) provides excellent environment for wind turbine and network interactions studies. The simulation environment used makes it possible to develop control strategies for wind turbines to qualify more demanding grid codes in the future. Minimization of simulation time is additional benefit.

Project target

In this project, the fault ride through (FRT) capability of both wind turbine concepts presented above are assessed. In addition, the different methods for achieving the FRT capability are compared and analyzed. The simulation results show that the full-power converter wind turbine concept has much more stable performance during network fault compared to DFIG concept. However, the fault ride through of DFIG concept can be enhanced by reasonable converter control during the fault.



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