Testing grid restoration with wind power plants

FCR provision and distributed power forecasts

ENERCON ENERGY FOR THE WORLD

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Motivation

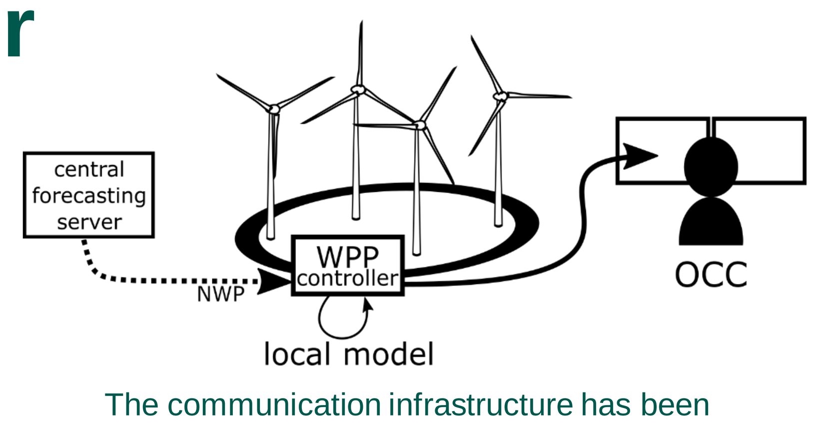
Grid restoration typically requires the generation units to supply a predictable active power level as well as frequency containment ancillary services. In order to enable WPPs to contribute significantly to grid restoration strategies, we present a performance evaluation of two key components:

- **decentralized blackout-safe forecasts**, which provide the grid operator even in critical situations with crucial information about $P_{Available}$, thus enabling FCR provision, and
- a dedicated power-frequency control mode (**incident control**), which is especially parametrized for grid restoration scenarios.

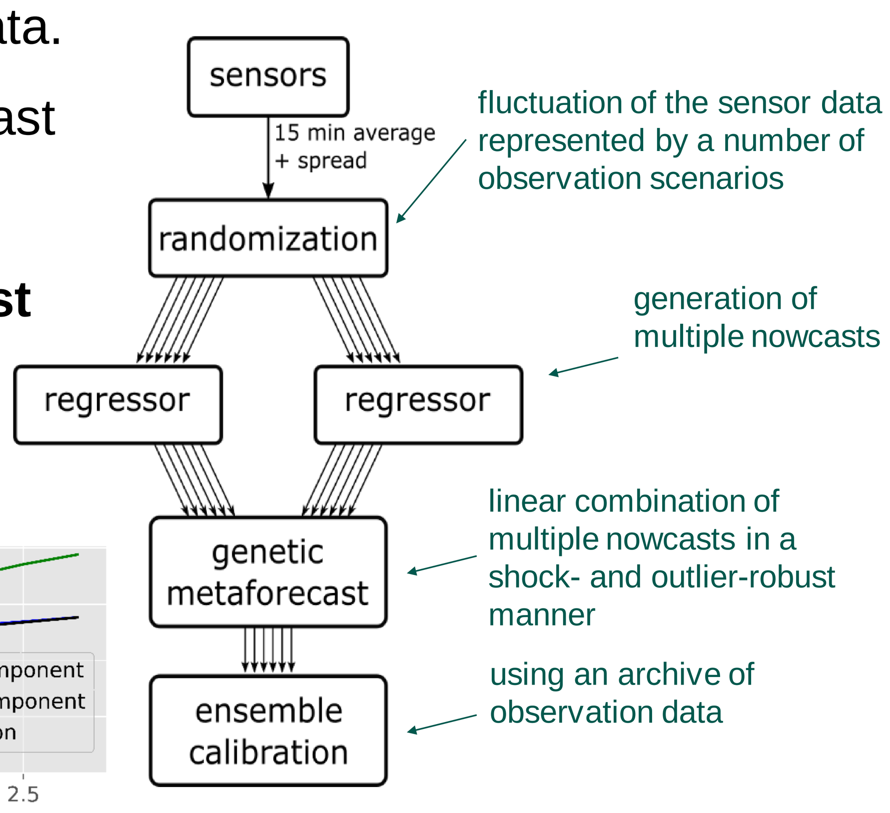
Both components were tested both in a laboratory environment as well as in an actual wind power plant (WPP).

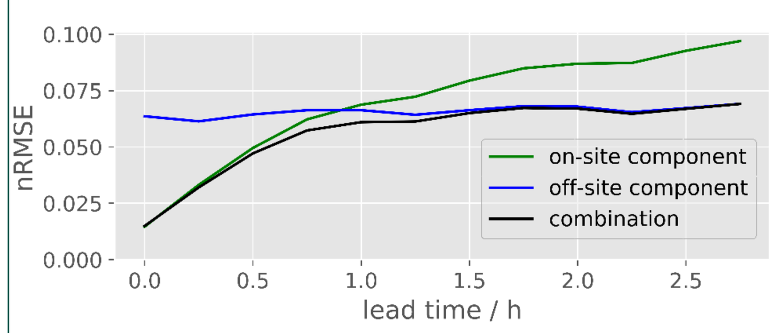
Distributed power forecast

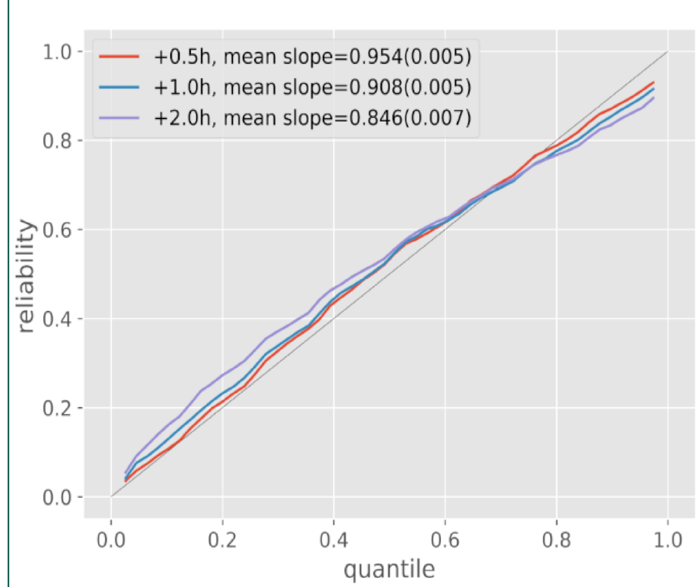
Probabilistic power forecasts are deposited in the WPP. On-site a local forecasting model improves the **nowcasting range** using local sensor data. The OCC can access forecast via conventional telecontrol interface → **blackout robust** availability



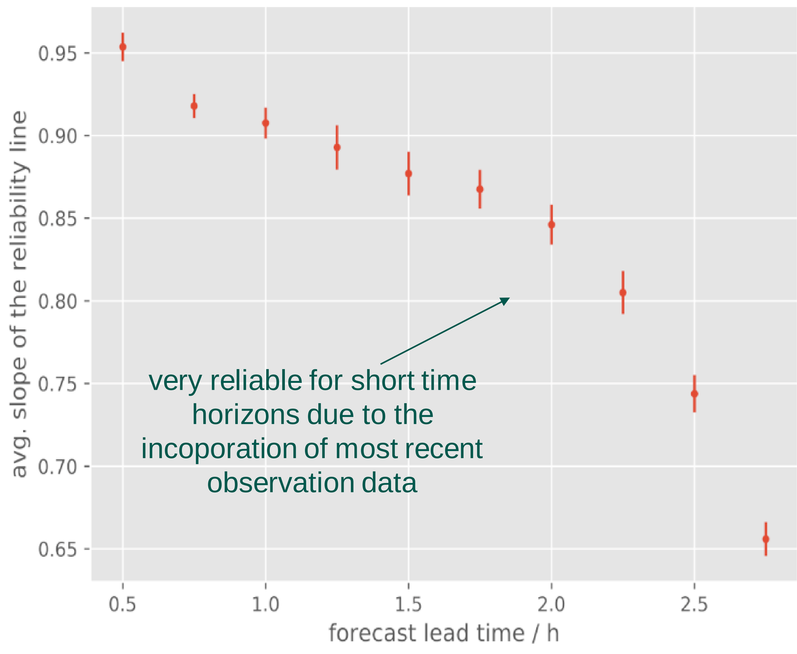
The communication infrastructure has been implemented in the test WPP







The reliability of the minimally available active power forecast is assessed by comparing the observed with the predicted frequency

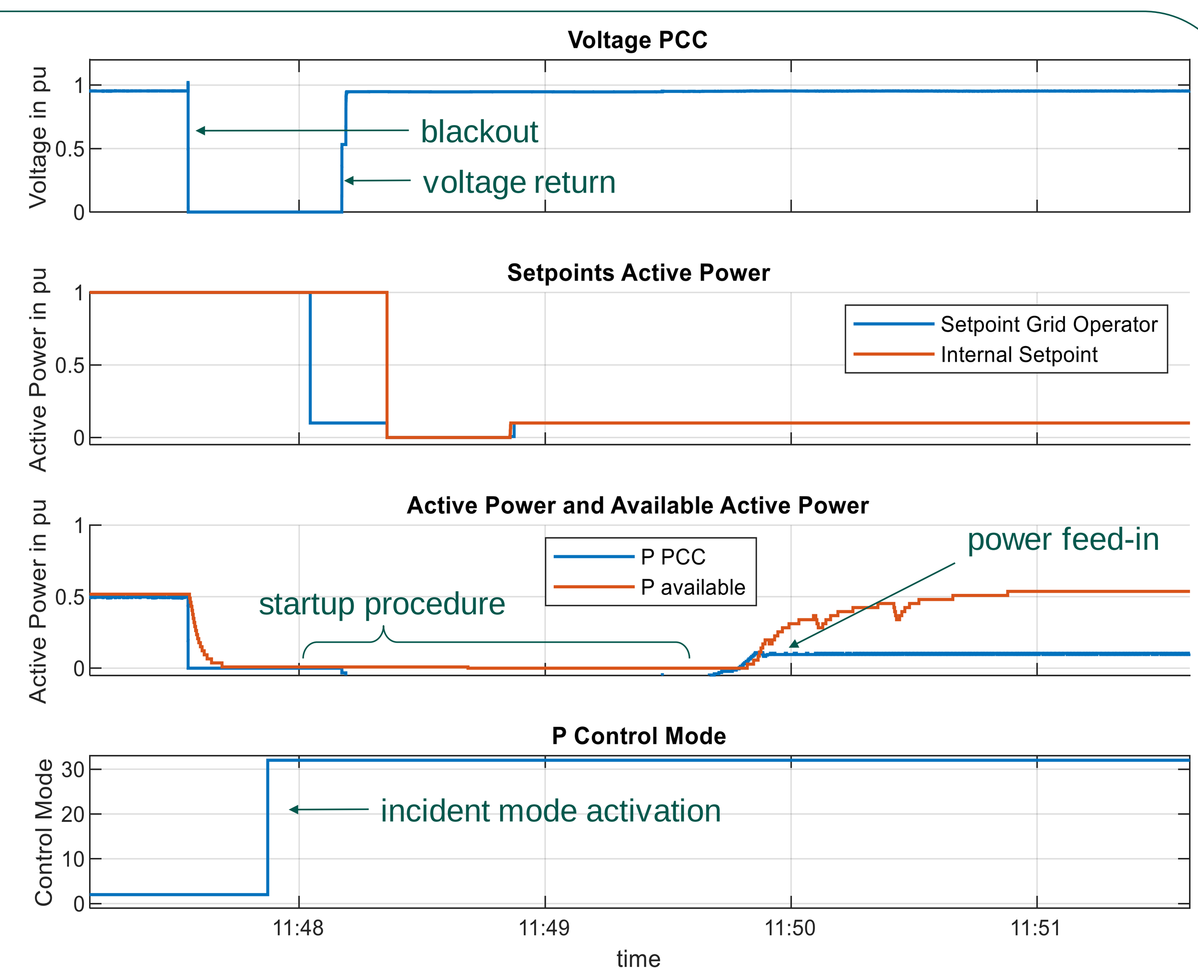


Laboratory test

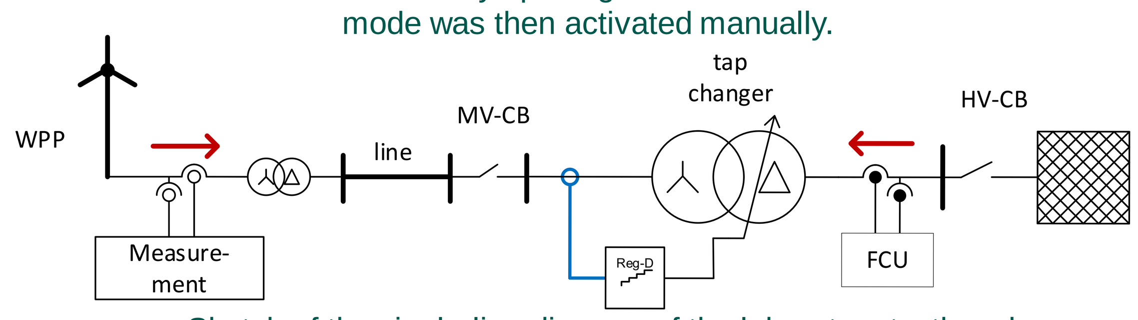
conducted at the Laboratory for electrical energy systems at the **Jade University of Applied Sciences**

Test objectives:

- activation sequence (manually and automatically)
- frequency containment (via f-setpoint changes)
- blackout tests (U=0 V at PCC, then return sequence)



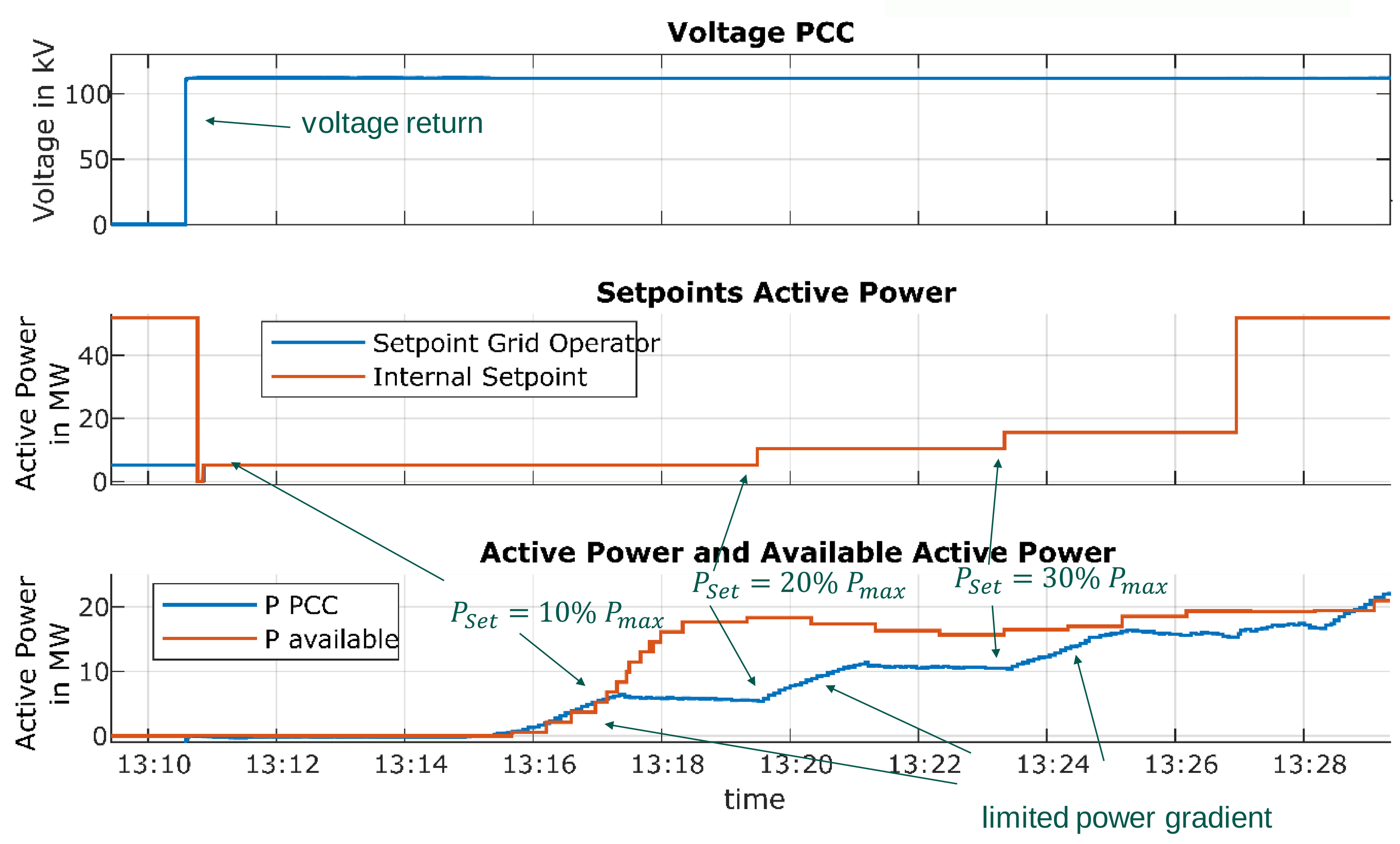
The blackout was simulated by opening the HV circuit breaker. The incident mode was then activated manually.

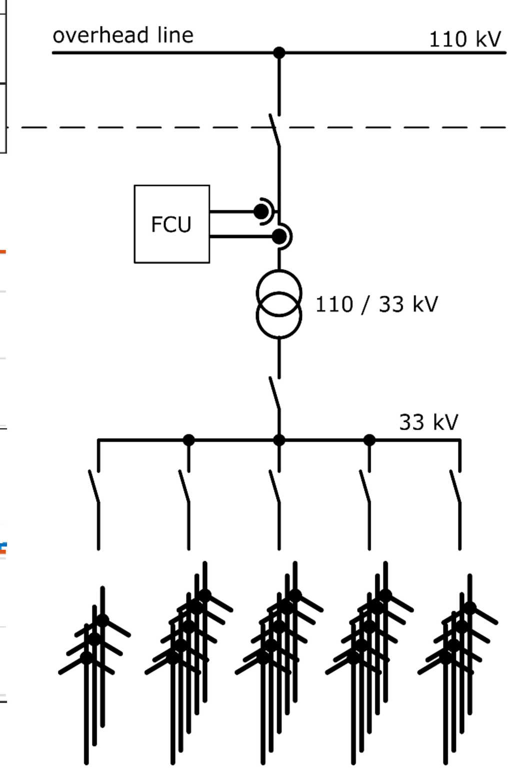


Sketch of the single-line diagram of the laboratory testbench

Field test

WPP, operated by Alterric, within the westnetz distribution grid

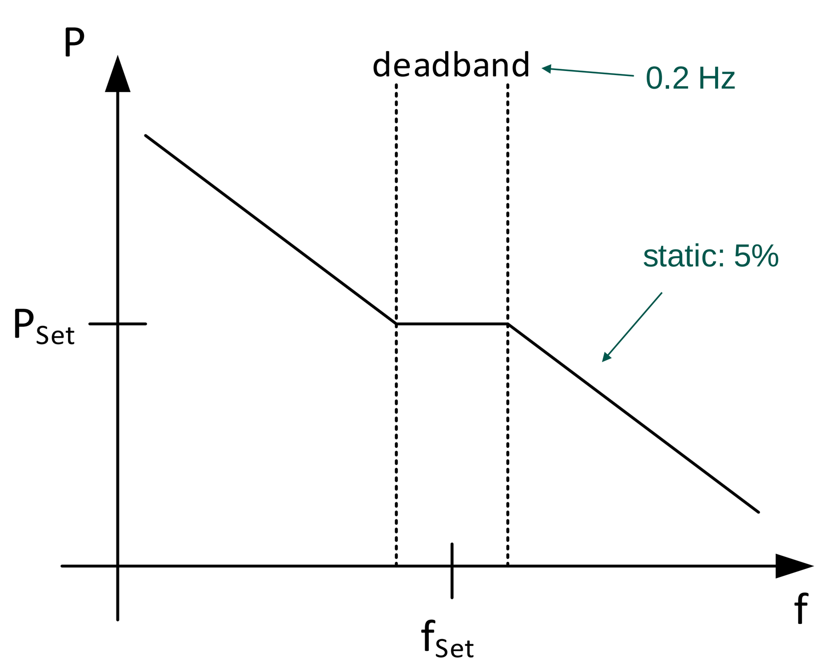




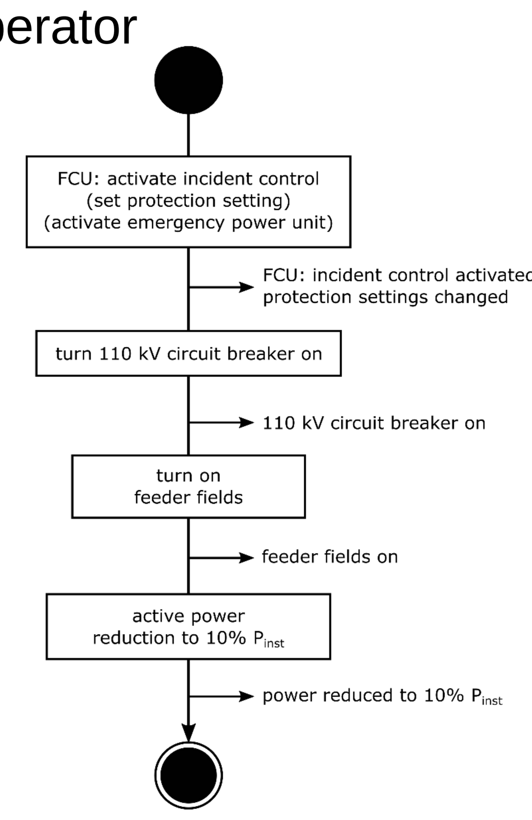
Blackout test: Disconnecting via overhead line, then manually activating the incident control mode. Here: Behaviour upon voltage return

Incident control

- optimizes the operation and integration of wind power plants during critical grid situations and during grid restoration by providing a variable f-setpoint and an integrated P(f)-curve
- preparation of the WPP for quick reconnection upon voltage restoration
- extended control access for the grid operator



Integrated P(f) curve



Activation sequence

Conclusion & outlook

- the decentralized forecasting infrastructure provided a high level of forecast reliability, especially in the nowcasting range
- laboratory tests provided an effective and cost-saving way to parametrize the incident mode
- with the field tests we were able to provide evidence, that WPPs can effectively be used to support grid restoration

References

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