

Loss Minimization in Long Offshore Wind Farm AC Export cables

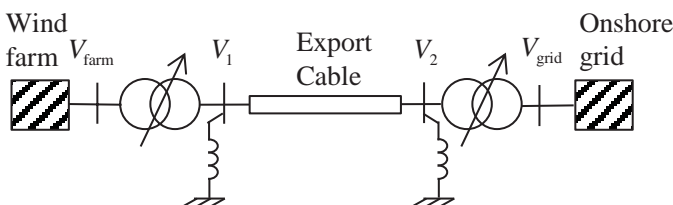
Innovation description

Losses in long distance AC transmissions can be substantially reduced by continuously adjusting the cable operating voltage according to the instantaneous wind farm power production. This is a new way to operate such transmissions and SINTEF Energy have used accurate cable models to demonstrate and quantify the potential loss reduction of this method.

Calculations for a 320 MW wind farm connected to shore via a 200 km cable at 220 kV nominal voltage shows that an annual loss reduction of 9% is achievable by simply using a $\pm 15\%$ tap changer voltage regulation on the two transformers.

The method is especially suited for wind farms since for long periods, wind farm production will be much lower than the maximum cable capacity. In these periods, the losses can be reduced by reducing the transmission voltage. The annual efficiency over the year can in this way be increased.

The methodology can be applied without introducing new technology that needs to be developed or qualified.



Losses are minimized by using tap changers on the transformers to obtain optimal transmission voltage for the current wind power (in general, lower voltage when production is low)

Impact

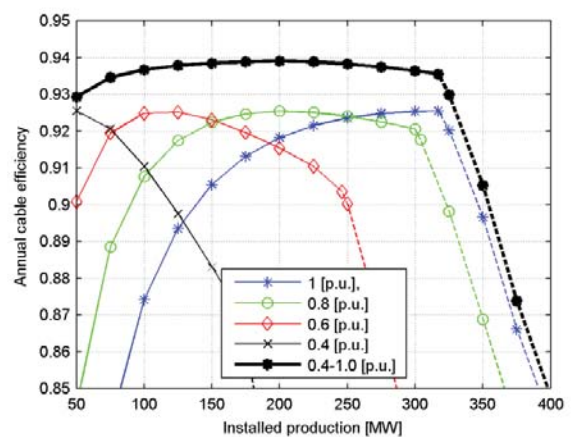
- Decreased losses in long AC transmission cables and therefore increased revenue for wind farm and transmission owner.

Further development

- The ideas are being further developed in NOWITECH.
- A planned outcome is a tool with a simple user interface allowing analyses to be performed without detailed insight into the methods

References

- B. Gustavsen, O. Mo, "Variable Transmission Voltage for loss minimization in long offshore wind farm AC export cables", accepted for publication in IEEE Transactions on Power Delivery
- O. Mo, B. Gustavsen, EERA Deepwind 2016 presentation, Feb 2016, http://www.sintef.no/globalassets/project/eera-deepwind2016/presentations/b2_olve-mo.pdf



Annual cable efficiency as function of wind farm maximum instantaneous production. The blue line is traditional operation with constant nominal voltage (1.0p.u.). The black is operation with variable voltage within range 40 – 100% of rated.