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| To | Participants in the tender for the off-shore wind farm at Kriegers Flak CC: DERA |
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Market and Technical framework for the Danish Kriegers Flak offshore wind park

This memo will describe the market and technical framework for the off-shore wind turbines located at Kriegers Flak and the interconnector between Eastern Denmark and Germany located at the Kriegers Flak.

The project for the establishment of an interconnector at Kriegers Flak is a joint project between the German transmission system operator (TSO) 50Hertz Transmission and the Danish TSO Energinet.dk. The project is co-financed by the European Commission's Recovery Program.

The content of this memo is the sole responsibility of Energinet.dk and any questions regarding the content should be forwarded to Energinet.dk.

1. Introduction

The grid connections for the Danish and German off-shore wind parks at Kriegers Flak will be the world's first off-shore grid that combines radial grid connections for off-shore wind and cross-border interconnection. The interconnector is planned to come into operation at the same time as the radial connection to the Danish on-shore grid.

Eastern Denmark and Germany will be connected via an interconnector between the Danish and German off-shore wind farms at Kriegers Flak. The interconnector will be fully integrated into the internal energy market and market coupling processes, which will ensure a socio-economic benefit from the cross-border trade.

The Danish off-shore wind park at Kriegers Flak will similarly be an integrated part of the price area in Eastern Denmark and will be a part of this price area in the day-head, intra-day and balancing markets.

The market framework for the Kriegers Flak off-shore wind farm and the market design for the utilization of the interconnector were approved by the Danish Energy Regulatory Authority (DERA) on the 29th of January 2014.

The market framework for the utilization of the interconnector will also be subject to regulatory approval by the German regulator Bundesnetzagentur.

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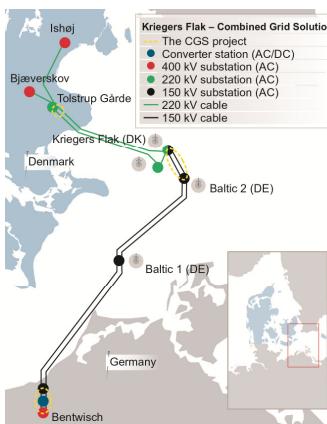


Figure 1: An illustration of the grid connection of the off-shore wind farm at Kriegers Flak.

2. The market framework for the use of the interconnector between Eastern Denmark and Germany on Kriegers Flak

The market framework for the interconnector at Kriegers Flak is closely related to the production of wind power at the off-shore wind farms. The off-shore wind farms have prioritized access to the national grid connections and the principle for the use of the interconnectors is that the remaining capacity will be given to the cross-border trade on the interconnectors.

The available capacity for cross-border trade will therefore be calculated on the basis of the “net-of-wind” principle, which is illustrated below in figure 2.

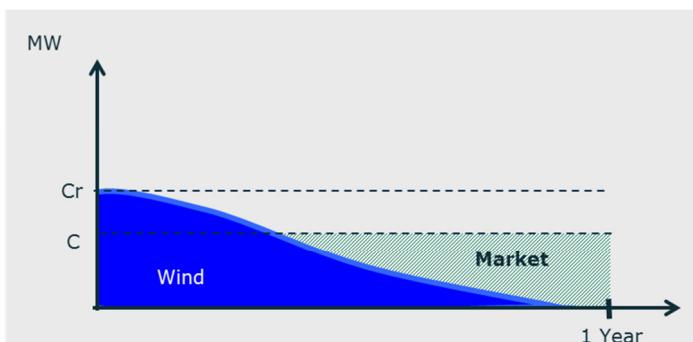


Figure 2: The capacity on the radial grid connection from the Danish off-shore wind farm to the Danish onshore transmission grid that can be used by the market is the area marked “Market”. The “net of wind principle” is illustrated by an off-shore wind production duration curve, where “C” is the installed capacity on the interconnector and “Cr” is the installed capacity on the radial connection to the Danish on-shore grid. The installed capacity on the radial connection corresponds to the installed capacity on the Danish wind farm.

The interconnector will be used for the cross-border trade within the internal market and the capacity will be made available for day-ahead and intra-day markets. The installed capacity on the interconnector is currently planned for 400 MW¹, and the capacity that can be given to the market will therefore vary between 400 and 0 MW depending on the wind production at the two off-shore wind parks.

¹ Grid losses on cables and convertors will also have to be taken into account when determining the available capacity to the market.

The planned installed capacity on the Danish off-shore wind farm (Cr in the figure above) is 600 MW.

The available capacity for cross-border trade on the interconnector will be calculated by the two TSOs based on their forecasts of wind power production at each national off-shore wind park.

The operator of the Danish off-shore wind park will therefore have access to the cross-border trade in the same way as any other market player in Denmark and all transactions due to cross-border trade will be between the TSOs.

The capacity on the interconnector on Kriegers Flak will be used in the market coupling mechanisms together with the existing interconnector Kontek between Eastern Denmark and Germany. An example of the calculation of the available capacities and the resulting day-ahead market flow is illustrated in appendix 1.

2.1 Outages on the Danish radial connection to the onshore grid

When the radial connection to the Danish onshore grid is out of operation, either due to outages or maintenance, Energinet.dk and 50Hertz will strive towards making the interconnector towards Germany available for transport of wind power production from the Danish wind park towards the German transmission grid. In such a situation all settlement will be done towards the Danish TSO and Energinet.dk will have the financial responsibility for all cross-border transactions.

Due to the size of the interconnector towards Germany (400 MW) and production at the German off-shore wind parks it is unlikely that all production from the Danish wind park in a hour can be transported to Germany. The available capacity for transport of Danish wind power to Germany will in these situations vary between 400-0 MW. The future operator of the Danish off-shore wind park and Energinet.dk will have to define the detailed framework for the production from the off-shore wind park in these situations.

The compensation schemes for a loss of production on off-shore wind parks in Denmark due to outages on the radial connections will also apply for the Kriegers Flak off-shore wind park.²

In a situation with an outage on the radial connection will the production at the Danish off-shore wind park also be settled at the spot and balancing prices in the price area in Eastern Denmark.

Any consumption of electricity by the Danish off-shore wind parks for stand-by purposes during periods of outages on the radial connections to the Danish onshore grid will have to be settled with Energinet.dk. Energinet.dk does not guarantee the possibility to have supply of electricity from the grid during periods of outages on the radial connection to the Danish on-shore grid.³

3. Market framework for off-shore wind turbines in Denmark and conditions for the wind turbines at Krigers Flak

The existing general market framework for market players in Denmark will also apply for the off-shore wind farm at Kriegers Flak and Energinet.dk's Regulation

² See the appendix to Energinet.dk's Regulation E, which can be found at www.energinet.dk

³ The requirements in Technical Regulation 3.2.5 will apply also to the off-shore wind farm at Kriegers Flak, despite the grid connection to Germany.

C1 and C2 sets up the general conditions for the operation of power plants and wind turbines in Denmark.⁴

The cross-border trade on the interconnector on Kriegers Flak will be facilitated by the Danish TSO according to the European Regulation for the internal energy market.

Rules for compensation for downregulation ordered by the TSO can be found in the appendix to Energinet.dk's Regulation E.

The normal balancing market regulation described in Regulation C2 will apply, meaning that the off-shore wind park will be a part of the balancing market in Eastern Denmark.

The Danish off-shore wind park at Kriegers Flak will be exempted from the balancing rules in Regulation C2 in situations with a full utilization of the grid connections towards Eastern Denmark. In these situations the operator of the off-shore park will not be able to net imbalances with other assets in the operators portfolio in Eastern Denmark, if the wind farm at Kriegers Flak experiences a higher than expected production. This is illustrated in figure 3 below.

This exemption applies to the Kriegers Flak off-shore wind park to avoid excessive incentives in the balancing of the price area in Eastern Denmark and the off-shore wind park at Kriegers Flak.

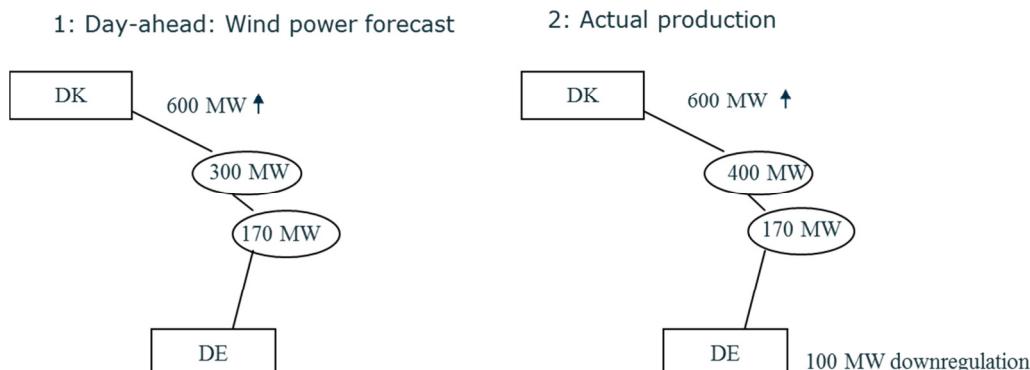


Figure 3: An illustration of congestion on the radial connection to the on-shore transmission grid from the Kriegers Flak off-shore wind park. The expected day-ahead production at the Danish off-shore wind park is 300 MWh/h, but the actual production during the operational hour is 400 MWh/h. The market determined flow on the interconnector is 300 MWh/h northbound from Germany towards Denmark resulting in a total planned flow of 600 MWh/h on the radial connection to the Danish grid. Due to higher than expected production at the Danish off-shore wind park will it be necessary to downregulate the market determined flow with 100 MWh/h in Germany.

In figure 3 is it assumed that a northbound congestion on the radial connection to the Danish grid day-ahead and a higher than expected wind power production during the actual operational hour leads to downregulation in Germany. The production from the off-shore wind park will in all situations have priority access to the grid and transport to the on-shore grid.

In situations with a lower than expected production at the off-shore wind park will the normal balancing framework apply, meaning that imbalance netting in a portfolio in Eastern Denmark will be a possibility.

⁴ Can be found at www.energinet.dk

3.1 Delivery of ancillary services from the Danish off-shore wind park at Kriegers Flak

The off-shore wind park at Kriegers Flak will be capable of delivering ancillary services in the same way as other off-shore wind parks in Denmark.⁵

4. Technical framework for Kriegers Flak off-shore wind park

The technical frameworks for the Danish wind power plant on Kriegers Flak includes, but are not limited to, certification aspects addressing human safety requirements, a set of technical minimum requirements for metering and related aspects, and a set of technical minimum requirements for granting a grid connection.

The technical regulation relevant for off-shore wind parks (power plants) in Denmark can be found in the following public available documents:

- Danish Executive Order no. 73 of 25 January 2013: Executive Order on the technical certification scheme for wind turbines.
- Technical regulation TR 5.8.1: 'Metering regulation for system operation purposes' of March 25, 2008, version 1, document no. 9300-08.
- Technical regulation TR 5.9.1: 'Ancillary services', 5 July 2012, version 1.1, document no. 91470-11
- Regulation D1: 'Settlement metering', December 2008, version 2, document no. 165903-07.
- Regulation D2: 'Technical requirements for electricity metering', May 2007, version 1, document no. 263352-06.
- Regulation E: 'Settlement of environmentally friendly electricity generation 2009', July 2009, rev. 1, document no. 255855-06.
- Regulation E – Appendix: 'Retningslinjer for nettoafregning af egenproduktion' (Guidelines for net settlement of own generation), version 1 of 1 July 2010, document no. 27582-10.
- Regulation E – Appendix: 'Compensation for offshore wind farms ordered to perform downward regulation', version 1, 15 May 2009, document no. 15468-09.
- Technical regulation TR 3.2.5:2014 'Wind power plants with a power output greater than 11 kW', revision 1, document no. 13/96336-43.

All documents are available on Energinet.dk's web site – www.energinet.dk

⁵ See Energinet.dk's Regulation C3 available at www.energinet.dk

Appendix 1: A theoretical example of the calculation of the available capacity for cross-border trade.

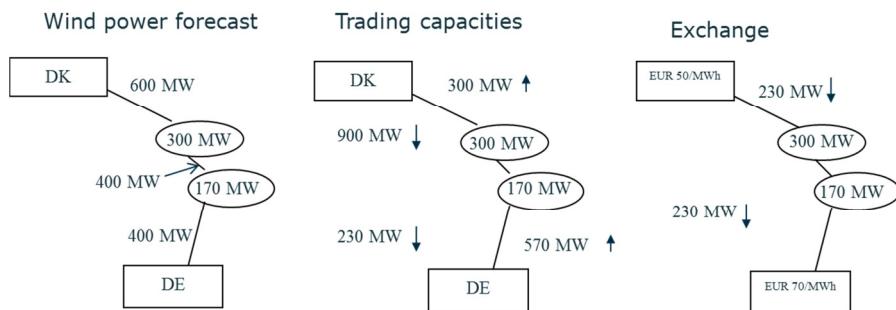


Figure 1: An illustration of the congestion management at the Kriegers Flak off-shore wind farm.

Figure 1 illustrates the three steps in the calculation of the available capacities for cross-border trade and the cross-border day-ahead flow. The capacity available for the cross-border market coupling is determined on the basis TSOs forecast of the wind power production of the two off-shore wind parks and the capacity on the interconnector.

The available capacity will be determined by the lowest capacity in each direction, which in the example in figure 1 is 230 MWh/h (400-170 MW) in southbound direction and 300 MWh/h (600-300 MW) in northbound direction, taking into account the capacity on the interconnector.

The resulting cross-border flow in figure 1 is a flow of 230 MWh/h in southbound direction due to high prices in Germany in this example.