

Kriegers Flak

Combined Grid Solution KF CGS



Link to YouTube film for the Combined Grid Solution KF CGS

<https://youtu.be/64h8MrR9zVU>

Kriegers Flak

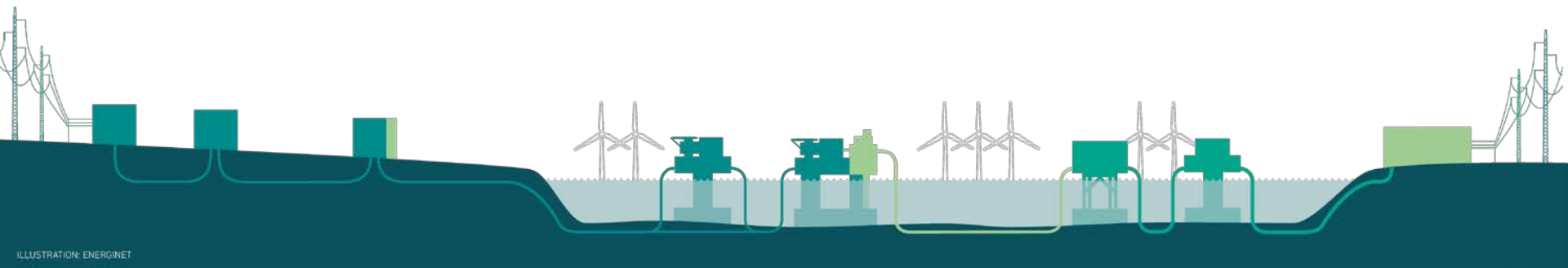
- Combined Grid Solution KF CGS

EC Workshop: Horizon 2050 power system and the role of HVDC technologies in a highly decentralised RES generation

- Brussels, 4 February 2020

Ole Stig Nissen, Energinet, Denmark

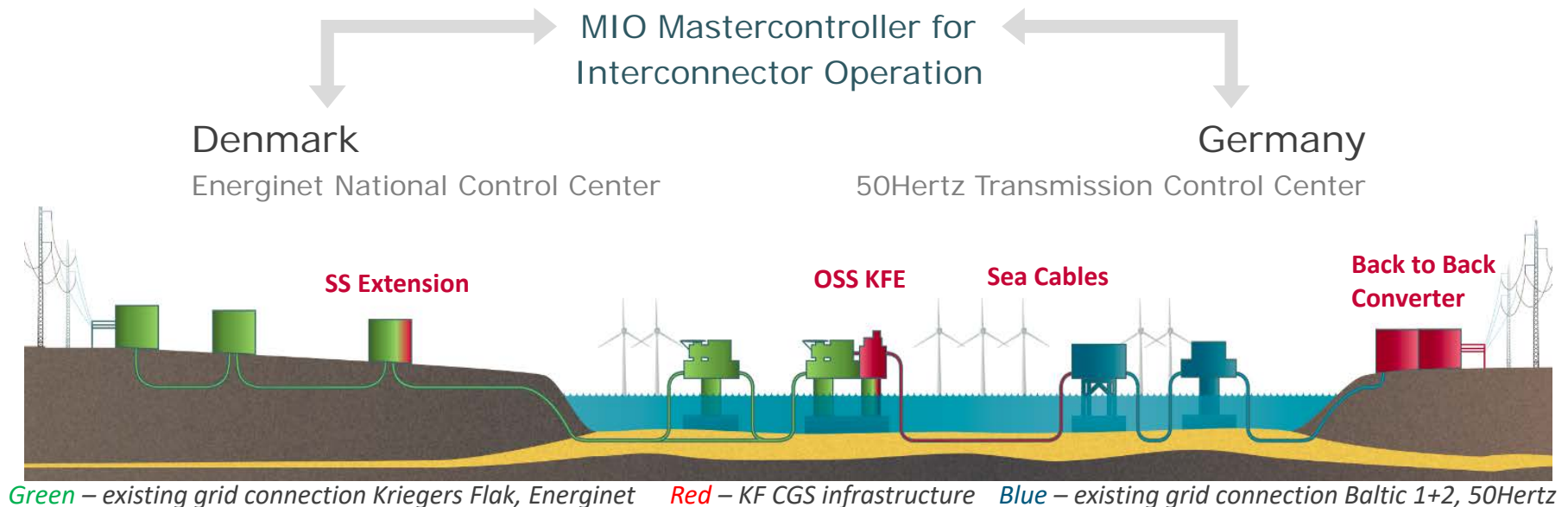
Sebastian Wagner, 50Hertz Transmission, Germany



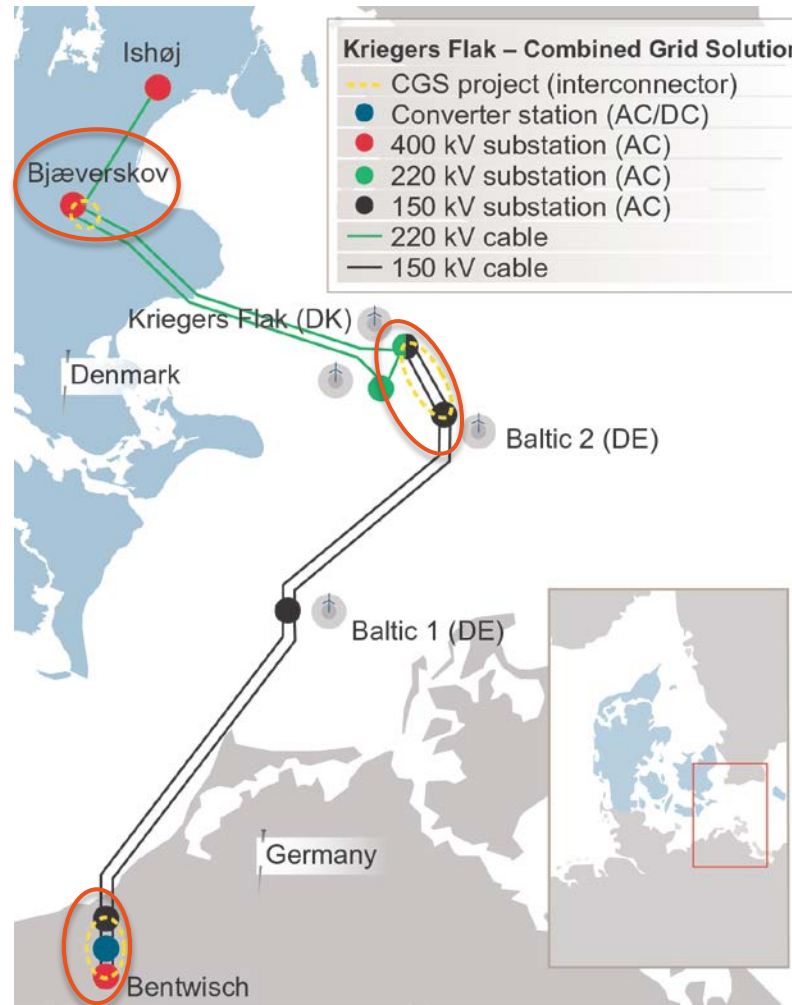
A common project of German TSO 50Hertz and Danish TSO Energinet, co-financed by the European Energy Program for Recovery (EU)

First hybrid interconnector/OWP system in the world - It combines:

- the radial grid connections of the German OWP's Baltic 1 & 2 and the Danish OWP Kriegers Flak with
- a cross-border interconnector between Denmark and Germany, connecting the German north-eastern region with the Danish area of Sjaelland
- controlled by MIO – a new kind of calculation and control system securing optimization of available capacities and flows of this complex system.



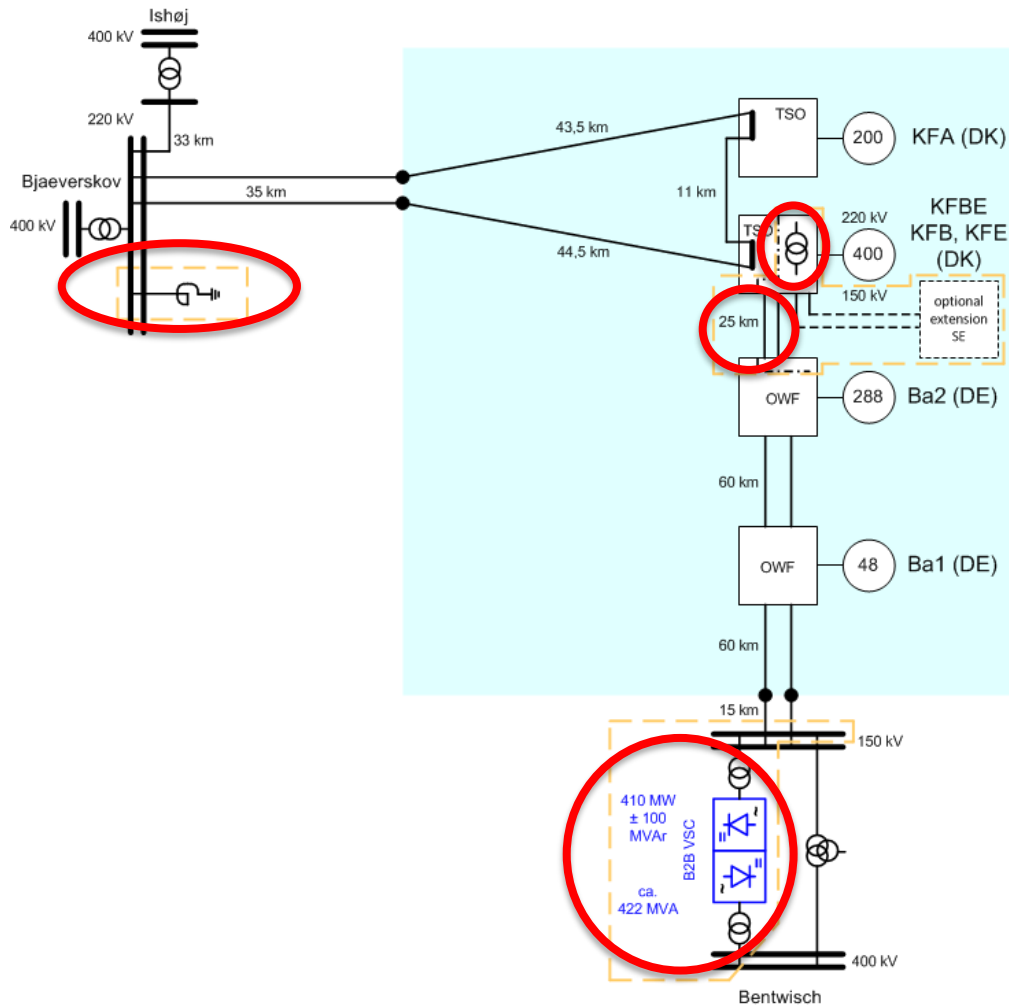
KF CGS – Hybrid Offshore Interconnector Germany - Denmark



KF CGS – Offshore Interconnector

KF CGS infrastructure, red (50Hertz + Energinet)

KF CGS – Basic Technical Concept

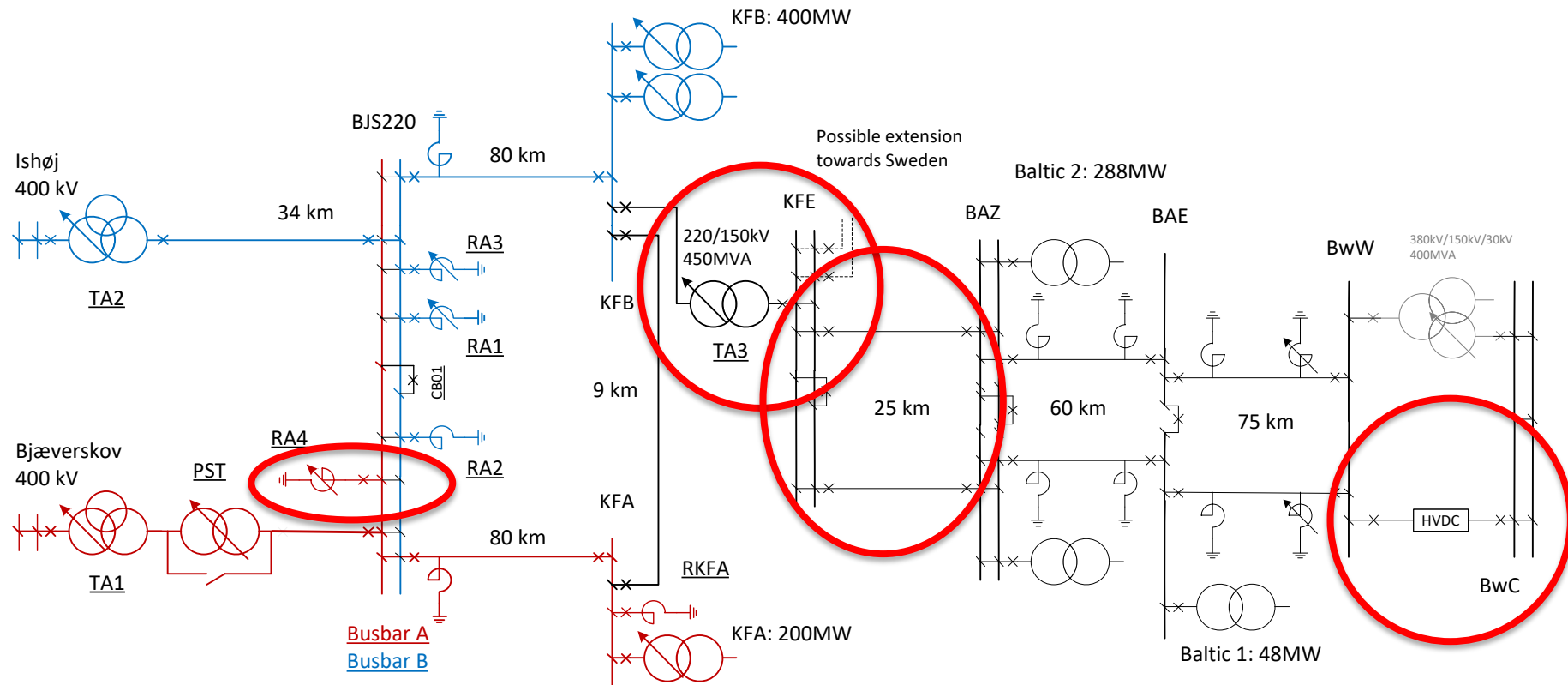


Main components

- HVDC Onshore B2B converter station Bentwisch including embedding into existing HVAC switch yard
- HVAC offshore platform Kriegers Flak KFE, extension of the existing OSS KFB (main module) by erection of a separate topside (extension module) on a shared foundation including a potential extension to Sweden
- HVAC Sea cable connection OSS Baltic 2 – OSS Kriegers Flak BE 2 x 150-kV-sea cables
- Extension of HVAC switch yard for a Shunt reactor in Bjaeverskov

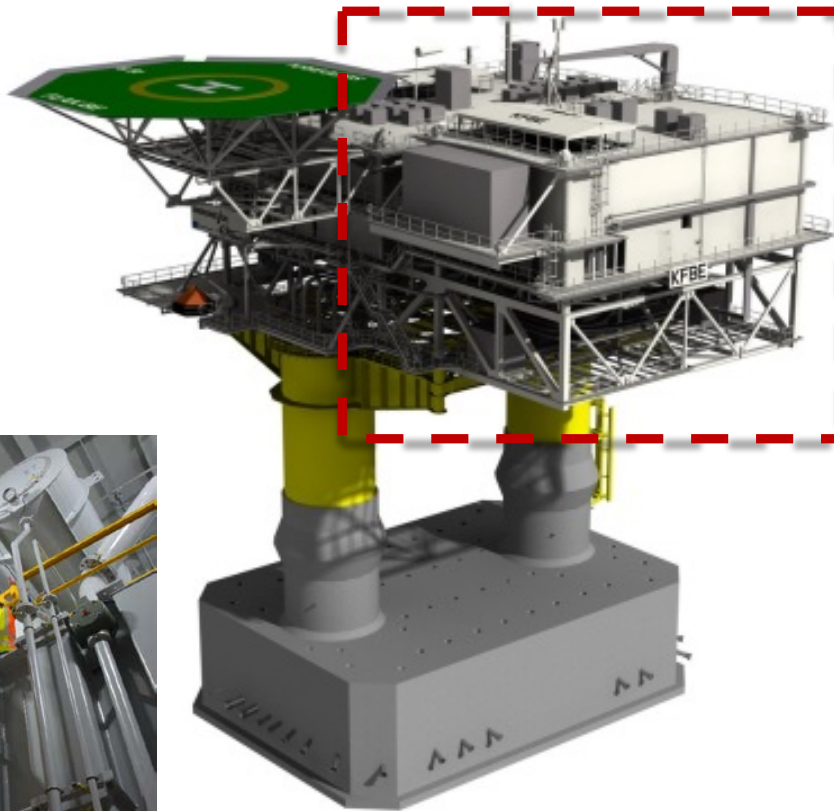
KF CGS – Technical Infrastructure

Kriegers Flak CGS – Electrical System Assets (SLD)



KF CGS Offshore Parts – OSS extension module KFE

- HVAC offshore platform „KFE“ as extension of Kriegers Flak OSS KFB



Offshore platform **KFB** (installed in 2018) connects OWF Kriegers Flak to the Danish onshore grid.

The **KFB** platform is combined with the extension module **KFE** on one gravity base foundation.

Main components on **KFE**: **transformer** (connecting point of the German with the Danish side) and **switchgear**.



KF CGS Offshore Parts – Sea Cables

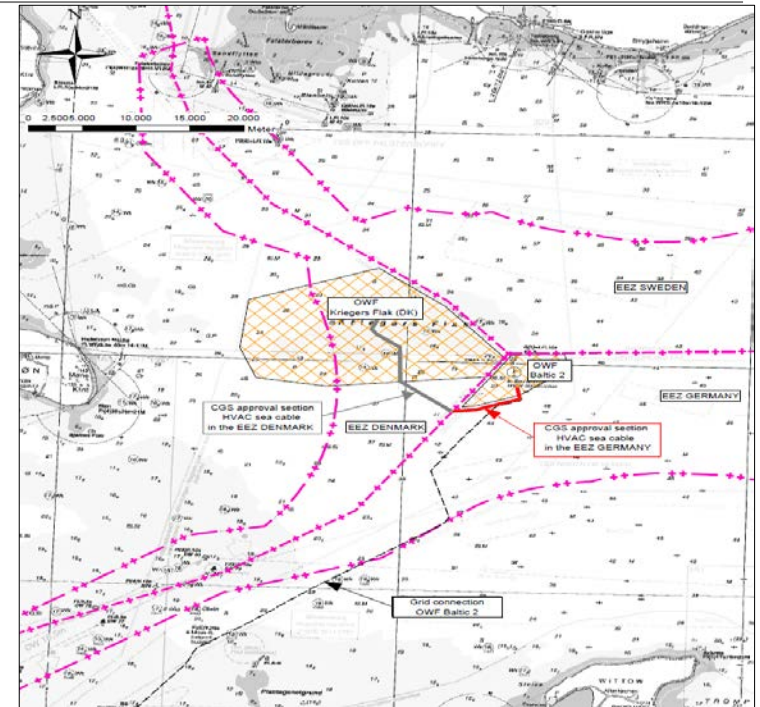
- 2 x HVAC sea cables connecting OSS Ba2 and OSS KFE



Type: 3-core-HVAC-XLPE-sea cables
Voltage: 150 kV
Power: ca. 200 MW
Length: 24 / 24,5 km
Diameter: 0,25 m
Weight: ca. 100 kg per meter



Cable Pull-in at OSS KFBE (Energinet, DK)
One of the two sea cables during installation campaign in front of KFBE platform



Sea cable route between OSS Ba2 and OSS KFE



Cable Pull-in at OSS Baltic 2 (50Hertz, DE)

KF CGS Offshore Parts – Extension of OSS Baltic 2

- Preparation of OSS Baltic 2 for CGS in advance already in 2015 together with the radial grid connection
- Extension of HVAC switchgear (GIS), cable deck, j-tubes, auxiliary systems



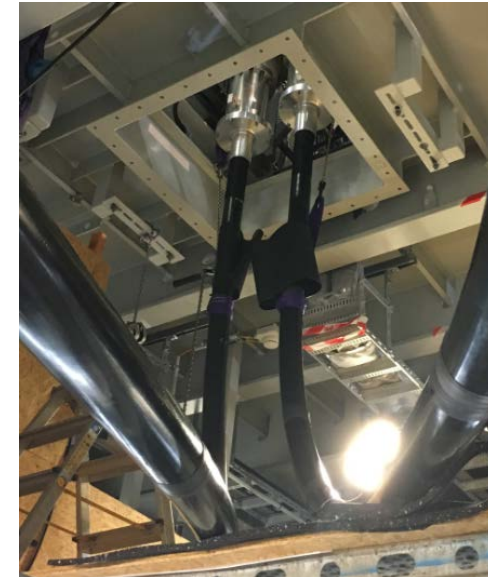
OSS BaZ (50Hertz, DE)
*In operation since 2015,
connecting OWF Baltic 2*



150-kV GIS
1 of 2 Reserve switch bays, 2015



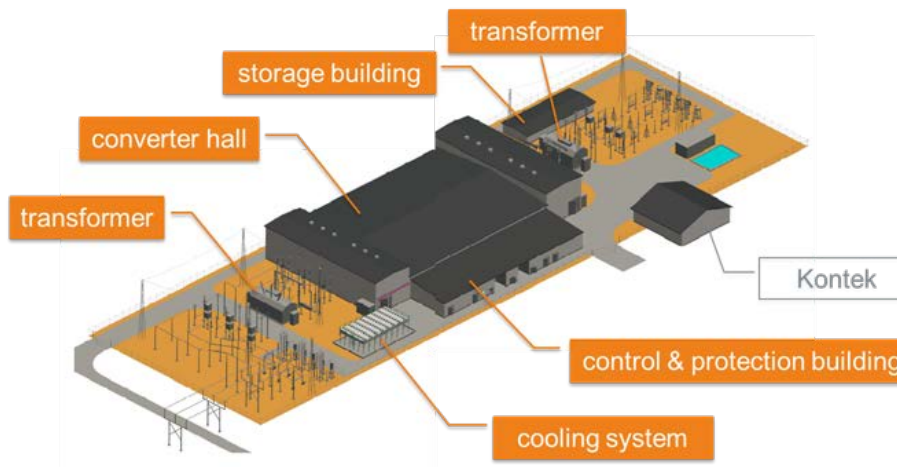
150-kV GIS
Termination works, 2018



150-kV GIS
Cable routing to GIS room, 2018

KF CGS Onshore Part - The Back to Back Converter in Bentwisch

Function of the plant



- **The Danish and the German transmission grids** operate in different phase, which makes a transformation AC – DC – AC necessary.
- **The so called back-to-back converter (BtB)** - consists of two voltage source converters (VSC) – which change the AC of the Nordic synchronous area into DC and directly back to AC, now adapted to the European synchronous area.

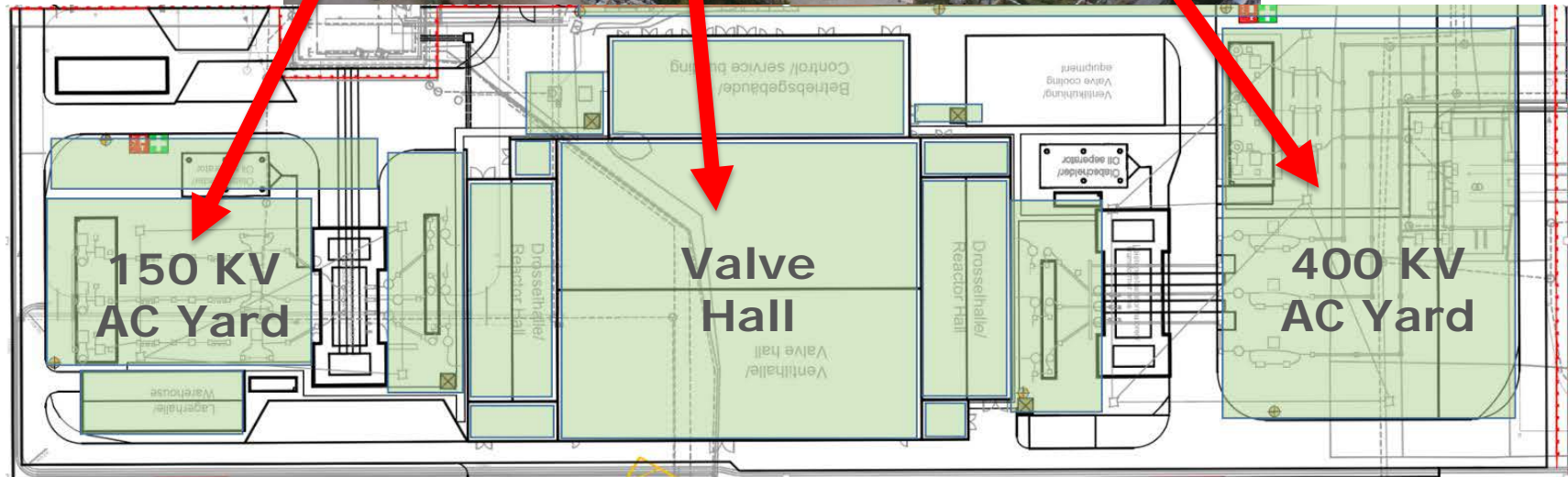
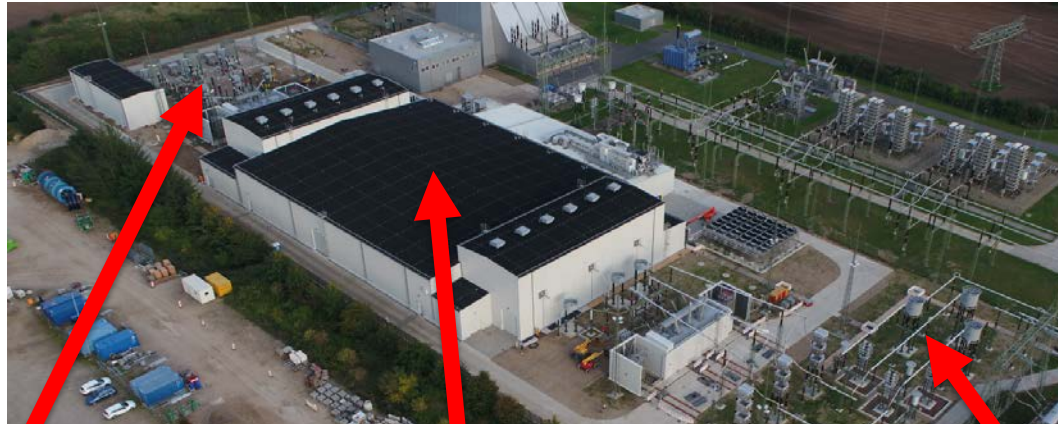
KF CGS Onshore Part - The Back to Back Converter in Bentwisch

Images of the plant



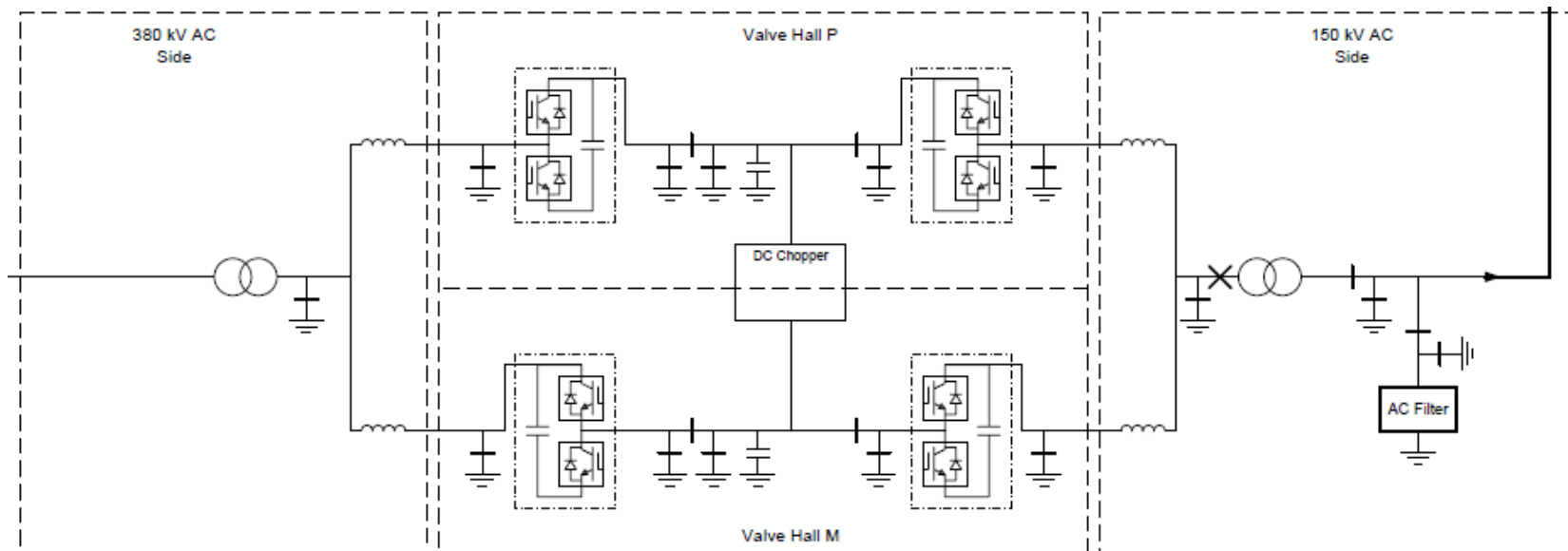
KF CGS Onshore Part - The Back to Back Converter in Bentwisch

Layout of the plant



KF CGS Onshore Part - The Back to Back Converter in Bentwisch

Electrical circuit for the plant



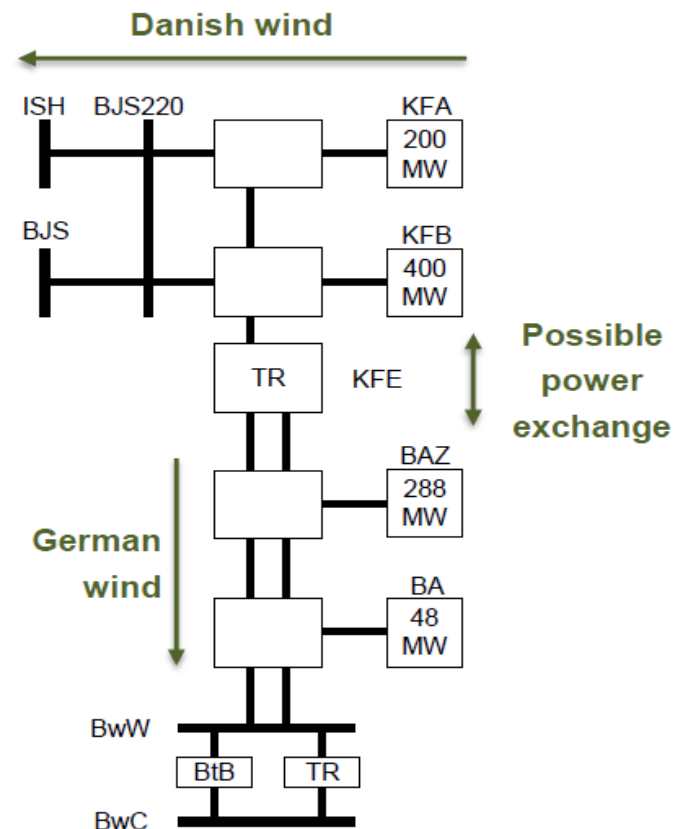
The MIO (Master Controller for Interconnector Operation)

KF CGS is the first interconnector between two countries (and bidding zones) that integrates infeed from two different national wind farms.

A new kind of calculation and control system is developed to control available capacities and flows of such a complex system.

Tasks of the MIO:

1. Calculating capacity for the market
2. Meet market results at POS
3. Avoid overload of equipment
4. Keep voltage limits for BtB and wind farms



Energy transport Business as usual – Offshore wind to land – high wind scenario



Energy transport Interconnector – Offshore wind to land – high wind scenario



Energy transport Interconnector – Offshore wind to land – high wind scenario



Energy transport Land to Offshore – then Offshore to land – Low/No wind scenario



Energy transport Land to Offshore – then Offshore to land – Low/No wind scenario



Status

- **OSS extension module KFE** was commissioned in 2018
- **Sea cables** were commissioned in 2018
- **BtB converter station** was energized in January 2020
- **Interconnector commissioning** is scheduled for Q1, 2020
- **Trial run** is planned for Q2. 2020
- **Project finalization** is scheduled for end of Q2 / 2020

Acknowledgements

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Thank you for the attention!

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