Horns Rev 3 & Kriegers Flak
Platform Interfaces

Technical Dialog Meeting
10 September 2013
Agenda

1. Location of platforms at the wind parks
2. Single line diagrams
3. Platform layout
4. Space for concessionaire on the platform
5. What concessionaire, operate and maintain on the platform
6. J-tubes and cable routing
7. Metering
8. Auxiliary power supply for concessionaire
9. Earthing resistors & earthing/bonding of equipment
10. Loading of transformers
11. Communication to shore
12. Back-up diesel generator
13. Cooperation agreements
1. Location of platforms at the wind parks - Krigers Flak

Coordinates
KFA (200 MW)
Easting: 748.250
Nothing: 6.103.800

KFB (400 MW)
Easting: 755.000
Nothing: 6.103.100

The two green circles indicate the position of the offshore platforms.
1. Location of platforms at wind park – Horn Rev 3

Coordinates in WGS84, UTM zone 32N
Easting: 417.400
Northing: 6.172.400
1. Single line diagrams – 400 MW platform

**Grid voltage in the wind farm:**
- 33 kV or 66 kV

**Number of wind turbine radials:**
- at 33 kV: 12 (3 x 4)
- at 56 kV: 6 - 9 (n x 3)

**High Voltage levels (HV):**
- 150 or 220 kV

**Horns Rev 3:** 220 (245) kV

**Kriegers Flak:** 150 (170) kV
1. Single line diagrams – 200 MW platform

Grid voltage in the wind farm:
- 33 kV or 66 kV
Number of wind turbine radials:
  - at 33 kV: 6 (2 x 3)
  - at 66 kV: 3 or 4

High Voltage levels (HV):
- Kriegers Flak: 150 (170) kV

*) Only if 33kV is chosen
3. Platform layout
3. Platform layout – main deck
3. Platform layout – mezzanine deck
3. Platform layout – roof deck
4. Space for concessionaire on the platform

- Rooms for MV switchgear;
- Room for SCADA and communication equipment
- Cable routes (trays) for MV cables
- Space for earthing resistors (close to auxiliary power transformers)
- Space for splice boxes for optical fibers from the wind turbines
- Space for radars, VHF-, Tetra-, GSM-antennas etc.
- Space on met-mast for weather transducers

- **Space is not available/foreseen for:**
  - Emergency power for the wind park (diesel generator, step-up transformer and reactor)
  - MV reactor for compensation of the MV park grid
5. What concessionaire owns, operate and maintain on the platform

- MV switchgear; (2 or 3 sections) with bays for: array cables and HV/MV transformers
- Earthing resistors: 2 at 200 MW platform and 3 at 400 MW platform
- MV Surge arrestors except for HV/MV transformers
- Communication and SCADA for control and monitoring of wind park, MW switchgear and park controller
- Sub-distribution panels for 220 V AC, 220 V DC for the MW switchgear and SCADA and communication system
- Splice boxes for terminating optical fibers from the wind turbines
- J-tubes in caissons for MV cables *)
- Cable trays for MV cables incl. supports *)

*) A lump sum to be paid
6. J-tubes and cable routing

• J-Tubes:
Following numbers of J-tubes will be installed on the platform:
At 400 MW platform:
  MV = 33 kV: 12 J-tubes
  MV = 66 kV: 6 - 9 J-tubes
At 200 MW platform:
  MV = 33 kV: 6 J-tubes
  MV = 66 kV: 3 - 4 J-tubes
The J-tubes will have an inner diameter of 315 mm (14”)
The bending radius will be min. 2200 m (app. 15 times an outer cable diameter of 150 mm)

• Cable routing:
Cable trays will be installed for routing of the array cable from the hang offs to the switchgear
Cable between MV Switchgear and hang-off ?
7. Metering

- The metering system to fulfill the requirements stated in Energinet.dk’s code “D2 – Tekniske krav til måling” which can be downloaded from Energinet.dk’s home page via:
  www.energinet.dk/DA/El/Forskrifter/Tekniske-forskrifter/Sider/Forskrifter-for-systemdrift.aspx
- Main and back-up meters will be installed by Energinet.dk.
- Current measurement: from current transformers built into the MV bushings of the HV/MV transformers
- Voltage measurement: from voltage transformers connected to the MV busbars
- Meters will be installed by Energinet.dk on the 0.4 kV side of each auxiliary power transformers for measurement of the energy used for the auxiliary power on the platform
8. Auxiliary power supply for concession owner

- For MV switchgear: 230 V AC secured and 220 V DC (redundant)

- For SCADA/communication: 230 V AC secured and 220 V DC (redundant)

- All cables between ENDK’s distribution panels and concessionaire’s equipment to be installed by concession owner
9. Earthing resistors & earthing/bonding

Earthing resistors

- Earthing resistors shall be installed at the star point of the MV side of each auxiliary transformer to reduce earth current in the MV grid.
- Concession owner is responsible for the design of the resistance, procurement and installation of the earthing resistors.
- If concession owner decide not to install earthing resistors then will the transformer star point be earthed directly.

Earthing/bonding

- To be established in accordance with ENDK’s Technical Standard “ETS-04 Earthing, bonding and lighting protection”

ETS can be downloaded from:

10. Loading of transformers

400 MW platform (Grid connection transmission capacity: 400 MW)

- The maximum loading of the transformers is:
  - with 3 transformers in operation: 130 MW ± 10 MW (normal operation)
  - with 2 transformers in operation: 200 MW ± 5 MW
- The switchgear to be designed to allow for switching between 2 or 3 transformers with the requested maximum loading of the transformers

200 MW Platform (Grid connection transmission capacity: 200 MW)

- The maximum loading of the transformers is:
  - with 2 transformers in operation: 100 MW ± 40 MW (normal operation)
  - One transformer in operation: 200 MW ± 5 MW
- The switchgear to be designed to allow for switching between 2 or 1 transformers
11. Communication to shore

- Fiber optic cable with 24 fibers will be installed between the platform and the cable station at shore.
- Up to 3 optic fiber pairs can be rented on commercial condition
- Back up communication will be established to shore by LOS communication link
- Limited capacity on the back-up link can be rented on commercial conditions.
12. Back-up diesel generator

- ENDK will install 2 back-up diesel generators on the platform;
  - one rated app. 100 kVA for domestic loads
  - one rated app. 600 kVA for supply of platform crane and fire pumps

- ENDK’s back-up diesel will **not** be designed for back-up supply for the wind park.
13. Cooperation agreements

- An cooperation agreement shall be established between ENDK and concessionaire.
- The agreement is to cover following issues during the installation period (but limited to):
  - Exchange of technical data
  - Assignment of MV switchgear contract
  - Access to platform
  - Test and commissioning (onshore and offshore)
  - Marine coordination
  - Safety
  - Time schedule