

**To Participating companies**

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Tonne Kjærvej 65  
7000 Fredericia  
Tel. +45 70 10 22 44  
Fax +45 76 24 51 80

info@energinet.dk  
www.energinet.dk  
cvr-nr. 28 98 06 71

## **Kriegers Flak Wind Farm Tender Q&A on interfaces 2nd February 2016**

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JCH/JCH

The Danish Energy Agency in cooperation with Energinet.dk hosts an information seminar on Tuesday the 2<sup>nd</sup> February 2016. The topic is interfaces related to the 600 MW Wind Farm at Kriegers Flak in the Baltic Sea and the grid connection to shore.

The prequalified companies had the opportunity to forward question before the seminar. The received questions have been compiled and answered in this document. The questions and answers can be distinguished by a capital A for Answer.

Some answers deserve further work and the final document will be submitted to the prequalified companies after the information seminar. This version is for inspiration and discussion only.

Question	Question/Answer
	<b>OSS (internal):</b>
1	<p>What are the weather / wave limits for the installation of the OSS (topside &amp; Foundation)?</p> <p>A: Pending substructure, topside and installation contractor.</p>
2	<p>Who has to provide the 33kV GIS? Which type off 33-kV-GIS is planned?</p> <p>A: The Concession owner (WFO) is to provide (buy and own) the 33kV GIS, please see tender appendix 6.1. The type of GIS is not locked to a specific manufacture.</p>
3	<p>What kind of overall protection concept will be carried out? (short circuit protection, redundant protection system, earth fault detection)?</p> <p>A: 220 kV is based on line differential and distance protection for backup. 220/33 kV transformer will be protected by differential protection and overcurrent protection.</p>
4	<p>If necessary, are the protection parameters and settings for the several steps of commissioning defined?</p> <p>A: Pending - No protection parameters are defined at the moment.</p>
5	<p>How is it planned to deal with an energized but unloaded 33-kV-cable system?</p> <p>A: These cables are not protected by Energinet.dk protection system. This is up to concession owner.</p>
6	<p>Are the relevant interfaces inside the OSS between the several operators defined?</p> <p>A: Interfaces inside the OSS will be addressed in a cooperation agreement between Energinet.dk and the concessionaire.</p>
7	<p>Who has got the responsibility for the operation of which cable, switchgear, switch (inside the SG), etc. inside the OSS?</p> <p>A: The Concession owner (WFO) is to operate the equipment, which the Concession owner owns and has the responsibility for. Please see tender Appendix 6.1</p>
8	<p>For the aux. power supply only a 400kVA-Transformer is planned. Has the aux. load calculation already been finalized? Is a load schedule available?</p> <p>A: Pending - A preliminary calculation of loads indicates a 400kVA auxiliary transformer. The load schedules are at this stage not available yet.</p>
9	<p>Which Cooling system for transformers and coils is planned (ONAN, ONAF, OFAF anything else)?</p> <p>A: ONAN</p>
10	<p>Which kinds of fire extinguishing system(s) are planned?</p> <p>A: Foam protection in reactor and transformer rooms. Inert gas in GIS and SCADA rooms. CO2 and ABC powder in day room and at diesel storage tank. If additional details are needed, it is possible to supply the six preliminary drawings: 271/272/273 H4 07 133 and 271/272/273 H4 07 134</p>
11	<p>Which range of climatic conditions is planned (temperature, humidity, salt content in the air)?</p> <p>A: The design premises for the equipment are: Ambient Temperature: -10C<sup>0</sup>/+25C<sup>0</sup> Humidity: 70 -100% R.H Enviroment: Exposed, saliferous salt-in air content 0.01 ppm</p>
12	<p>Is a redundancy for the HVAC system planned?</p> <p>A: Yes - the HVAC system (Heating Ventilation Air Condition) is designed as a redundant system. The system consists of a dehumidifier and booster fans operating redundant and in alternated operation.</p>
13	<p>How will the OSS be energized during the commissioning offshore and the cable pull in?</p> <p>A: The OSS will be powered by the diesel generator installed on the OSS.</p>

14	Who is responsible for possible switching operations on the 33kV GIS during the commissioning and testing phase? A: Concession owner is responsible for operating his own equipment.
15	Who is responsible for the cable connection between 33kV GIS and the transformers? A: It is in the responsibility of the Concession owner (WFO).
16	Is access via Ampelmann-System foreseen? A: The platform has not been prepared for access via the Ampelmann-system
	<b>OSS (interfaces for cable installation (33/220kV):</b>
17	Are there installations for the cable pull in and the cable routing inside the OSS foreseen? A: Yes, the OSS's has been designed with a 33kV cable routing and layout to fit the OSS's. The Concession owner owns, pays, operates and maintains the 33kV cable routing including support. For the 33kV cable pull in, only strong points are foreseen.
18	Is the power consumption for the cable pull in already defined? A: The will be a 63A CEE socket (maximum 63A) available for the cable pulling winch.
19	Are the pre-conditions for the cable pull already defined (qty. of staff and the facilities for them, required space for interim cable storage until routing, illumination, restricted areas during the pulling)? A: The OSS design is complete; hence conditions for cable pull-in are fixed. Allowed personnel on the substation is 12, however the number of personnel to be present shall be coordinated with Energinet.dk. Storage area, illumination and restrictions related to cable installation is pending final design of the substructure.
20	Which is the connection point for the subsea cables to the OSS (33-kV-GIS bushings, pre-installed joints close to the hang offs)? A: The connection point for 33kV subsea cables is in the concession owners 33kV GIS.
21	Is the foreseen 33-kV-GIS capable to be connected to the IAG during the HV-Testing of the subsea cables? A: It is in the responsibility of the Concession owner (WFO).
22	Which kind of cable protection system is planned for the free span between lower end of the J-/I-Tubes and the seabed? A: No cable protection system is planned for 33kV subsea cables, expected distance between bell-mouth and existing seabed is to be 500 mm.
23	If some kind of cable protection system is planned, are any additional installations necessary for the installations of it? A: No cable protection system is planned for 33kV subsea cables.
24	How is the arrangement of the 33kV J-/I-Tubes and the 220kV J-/I-Tubes? A: J-tube design is made with reference to DNV-RP-J301, and has the characteristic as stated below: <b>J-tube size:</b> 33kV Array min. ID 350 mm <b>Dist. between hang-off:</b> Min. 1000 mm <b>J-tube/bell-mouth restrictions:</b> Min. dist. Between bell-mouth 1500 mm (maximum dist. shall be design driver) Min. dist. from concrete wall to end of bell-mouth 500 mm Expected distance between bell-mouth and existing seabed to be 500 mm 33kV J-tubes are allowed to have one additional bend besides the main bend from vertical to horizontal (approx. 75 degree), the bend may not exceed 25 degrees. Please be advised that additional bends shall be avoided if possible.
25	Which kind of the installation sequence of the 33kV and 220kV cable is foreseen? (33kV

	for, after or in-between the 220kV cable pull-in and installation) A: Installation of 220kV subsea cables is foreseen to be done immediately after topside installation, hence the 220kV subsea cables is installed before the 33kV subsea cables.
26	Is it planned to handover certain areas too other parties during their initial works in these areas? A: Question needs further explanation
27	How will the interface design meetings be handled? A: Energinet.dk anticipates a contact group composed by relevant team members from the Topside project group and relevant members from the Concession owner (WFO). The parties will meet on an agreed frequency.
28	First draft of Interfaces and Scope-Split Matrix available? A: Pending - The interface and scope split are not yet available.
	<b>General/organizational questions:</b>
29	Is it obligatory to have documentations also in Danish language or is an English documentation legal? A: Energinet can accept documentation in English only. However there might be QHSE documents, which for legal reasons must also be in Danish
30	In Appendix 6 (Concession agreement) it is written: "The electricity from the offshore wind farm plant must be transmitted onshore to the Danish collective electricity supply grid." In Appendix 6.1 (1) is written: "It will be possible to use this electricity grid to route wind turbine electricity onshore and to exchange electricity between Denmark and Germany." à is it allowed to transmit electricity to Germany and trade it at the German electricity exchange A: The quoted text in tender appendix 6.1 is intended for a general description of the electrical connection between Denmark and Germany via Kriegers Flak. The off-shore wind park will be an integrated part of the price area in Eastern Denmark and no special conditions will apply to the off-shore park in terms of cross-border trading. All cross-border capacity will be given to the day-ahead market coupling. The off-shore wind park will not be able to trade directly in the German price area and the off-shore wind park will be an integrated part of the price area in Eastern Denmark in the day-ahead, intra-day and balancing markets.
31	Who regulates the feeding-in power of the two wind farm areas (reduction, shut-off) – the concessionaire or Energinet.DK? A: It will be up to the concessionaire to regulate the feeding-in of power from the two wind farm areas, in the same way as any other production facility. The same procedure will also apply to scheduling etc. In case of limitations in the grid Energinet.dk will inform the concessionaire of the consequences according to the relevant regulations. Please note that Energinet.dk will compensate the concessionaire according to section 9 in the tender documents.
32	Does Energinet.DK contract a third party to operate the two transformer platforms? A: No. Energinet.dk will operate the two platforms.
33	Which response time will be adhered to for maintenance, repairs and trouble shooting in case of AC power or transformer platform failure? A: Trouble shooting will be initiated within hours depending on severity of fault. Under normal weather conditions platform visit is possible same day by helicopter. Maintenance disturbing the wind farm operation is not foreseen in the concession period. In the event of planned outage Energinet.dk will look for weather windows with low wind. Please note that Energinet.dk will compensate the concessionaire according to section 9 in the tender documents.

34	<p>How many days a year will be the two transformer platforms shut down for maintenance by Energinet.DK? How many days in advance will Energinet.DK inform the concessionaire?</p> <p>A: Maintenance disturbing the wind farm operation is not foreseen in the concession period. The close dialogue between Energinet.dk and the concessionaire will support information exchange on short notice.</p>
35	<p>How many days a year will be the Export grid shut down for maintenance by Energinet.DK? How many days in advance will Energinet.DK inform the concessionaire?</p> <p>A: Maintenance disturbing the wind farm operation is not foreseen in the concession period. The close dialogue between Energinet.dk and the concessionaire will support information exchange on short notice and if possible well in advance.</p>
36	<p>Will there be a warranty of availability by Energinet.DK to the concessionaire?</p> <p>A: Energinet.dk will compensate the concessionaire according to section 9 in the tender documents.</p>
37	<p>Will there be any refund by Energinet.DK to the concessionaire for planned and / or unplanned shut down of the two transformer platforms or the export grid?</p> <p>A: Energinet.dk will compensate the concessionaire according to section 9 in the tender documents.</p>
38	<p>Who is the nominated person in control of an electrical installation for the two transformer platforms?</p> <p>A: The nominated person will be stated in the operational agreement. (driftsleder aftalen)</p>
39	<p>What is the general setup of the OSS? Waste disposal? Waste Water/fresh water?</p> <p>A: The OSS is designed in accordance with DNV-OS-J201, in relation to waste disposal grey water is foreseen to be discharged via a skim-pile, other waste types is to be transported to shore and disposed acc. to local regulation.</p> <p>Technical water will be supplied from shore in tanks, for sanitary purposes.</p> <p>Drinking water will be supplied as bottled water.</p> <p>Cleaning water (Sea water), intended for cleaning of the helideck etc. will be supplied from a submerged pump.</p>
40	<p>Is it possible for the concessionaire to operate the two transformer platforms for extra money?</p> <p>A: No. Energinet.dk will operate the two platforms.</p>
41	<p>Are there any technical guidelines / specifications for the remote control of the two transformer platforms and therefor for the wind farm plant?</p> <p>A: No. Energinet.dk will operate the two platforms. The operational aspect of the wind power plant is purely in the responsibility of the wind farm owner.</p>
42	<p>Do specific transformer platform right of access plans exist by Energinet.DK? Is the concessionaire always allowed to enter its 33 kV installations, SCADA and communications systems installed on the two transformer platforms or are there application regulations?</p> <p>A: Access to the Energinet.dk offshore platforms will be agreed with the concessionaire. Please visit appendix 6.1.1 for a sample agreement.</p>
43	<p>Are there any obligatory qualifications to enter the transformer platforms?</p> <p>A: Offshore work</p> <p>No personnel shall visit or be assigned to work offshore until satisfactory evidence that such personnel have attended offshore safety training courses in accordance with the table below. Courses according to GWO-standard will be accepted and other types of course may be approved by ENDK if found fit for purpose.</p>

<i>Requirements and courses to be acquired</i>								
	ID-card	Introduction substation /boat	NOK-formula	Health Certificate	First Aid	Safety at sea	Fire awareness	
	Passenger who stays on crew/service boat	✓	✓	✓				
	Access to the substation	✓	✓	✓	✓	✓	✓	✓
	Course validity	Project	Project	Project	2 Year	2 Year	4 Year	2 Year
	Visitors	✓	✓	✓				
44	<p>Does Energinet.DK provide the fibre optic cable to rent utilization to the concessionaire or is Energinet.DK willing to provide a communication network up to the junction point of the Danish communication network?</p> <p>A: Please see appendix 6.1</p>							
45	<p>Does Energinet.DK consider a renting or leasing agreement concerning Rooms on the OSS topside? Are there additional office rooms available? Shared office space?</p> <p>A: Due to the compact design of the two platforms, it will not be possible to rent or lease additional rooms on the OSS topside and there are no additional office rooms available. There will be a dedicated WFO room with office space and the day room can be shared</p>							
46	<p>Fault recording device</p> <p>Are there any specific requirements to the type and make of fault recorders to be installed according to TF 3.2.5.?</p> <p>Can it be confirmed that ENDK will not need direct access to fault recorders, instead data shall be submitted on request.</p> <p>A: Energinet.dk is not specifying the specific products of fault recorder as long as they fulfil the requirements stated.</p> <p>According to TF 3.2.5 an online communication to fault recorders is <b>not</b> required, but offline transfer of data via files in COMTRADE formats is required.</p>							
47	<p>Onshore substation</p> <p>Are there any specific requirements to the onshore substation structure for Generators communication equipment? Is it correctly understood that it may be placed at ENDK premises and provided with LVAC supply from ENDK?</p> <p>A: The generator is not anticipated to have onshore substation equipment. Please explain further.</p>							
48	<p>VTS system</p> <p>Does ENDK have knowledge of any consent requirements for a full VTS system?</p> <p>A: No, Energinet.dk has not knowledge of any requirement for a full VTS system.</p>							
49	<p>Only one transformer on OSS KFA</p> <p>With only one offshore main transformer on OSS KFA, all WTGs connected to that OSS will be without grid supply, if the main transformer is out of service. Does ENDK have any availability numbers for the grid connection of the WTGs connected to OSS KFA?</p> <p>A: Availability numbers are not available – a spare transformer is available onshore.</p>							
50	<p>In case of failure of the main transformer, earthing transformer, earthing system, etc. what is the expected Mean Time and Maximum Time for re-establishing grid connection to the WTGs.</p> <p>A: Within six weeks – spare transformer is available onshore.</p>							
51	<p>Can ENDK if Generator will only be compensated for lost production during the grid outage, and not other costs directly related to the grid outage, such as costs related to diesel generators, etc. and lost production due to extra service required on the WTGs related to a long stand-still period.</p>							

	<p>A: Energinet.dk will compensate the concessionaire according to section 9 in the tender documents.</p>
52	<p>Neutral Earthing resistor.</p> <p>In Appendix 6.1.1 – Collaboration Agreement during the Construction Phase, Section 4.6 Earthing resistors it is stated that the 33kV system will be earthed using an NER of 20 ohm. However in the Tender Conditions, Appendix 6.1 following is stated in Section 5.5 Short-circuit currents and zero resistors: “Calculations for dimensioning zero resistors must be carried out by the concessionaire and submitted to Energinet.dk for approval.”</p> <p>Is it possible to change the size of the NER, if detailed short circuit studies reveal an insufficient damping of earth fault currents with a NER of 20 ohm?</p> <p>A: Yes, it is possible.</p>
53	<p>Short circuit level</p> <p>In the Tender Conditions, Appendix 6.1 following is stated in Section 5.5 Short-circuit currents and zero resistors: “In connection with the three-phase short circuit on the 33 kV side of the 220/33 kV transformers, Energinet.dk's transformers will contribute to the short-circuit current with a maximum of 21 kA on both KFA and KFB. Moreover, the wind turbines will also contribute to the resulting fault currents. The fault currents are therefore likely to become significantly larger than these values, both in connection with three-phase short circuit and short-circuit to earth.”</p> <p>In Appendix 6.1.1 – Collaboration Agreement during the Construction Phase, Section 3.4 Short circuit level there are two tables showing maximum and minimum short circuit calculations. In the table worst case load a short circuit current of 27.73kA is stated for KFB (400MW) 33kV – A.</p> <p>Are the calculations for normal operation with both transformers in operation on OSS KFB or is it with only one transformer in operation on OSS KFB, hence all WTGs are connected to one transformer?</p> <p>A: The short circuit current of 27.73 kA is for the unusual situation with only one transformer in operation on OSS KFB – hence all WTGs are connected to one transformer.</p>
54	<p>Has ENDK conducted a cost-benefit analysis considering the cost impact on the wind farm design if short circuit level is above 25 kA.</p> <p>Will ENDK consider increasing the transformer SC impedance?</p> <p>A: The aim is to limit the short circuit current at 33 kV level to a maximum of 25 kA. In the transformer bid it has been ensured that a high SC impedance is delivered.</p>
55	<p>Moving of production capacity from the eastern area to the western area</p> <p>If the concessionaire wishes to move some production capacity from the eastern area to the western area within the limit of 60MW, can ENDK please clarify the boundary conditions for the routing of the array cable connecting the WTGs in the western area to the OSS in the eastern area?</p> <p>This question relates to crossing of export / interlink cable, orientation and position of J-tubes on OSS etc.</p> <p>A: The wind farm array cables must not cross the Energinet.dk export cables, nor the interconnector cables towards Germany.</p>
56	<p>Grid code requirements to Power Quality</p> <p>Following requirements are stated in the Technical regulation 3.2.5 for wind power plants with a power output above 11 kW:</p> <p>4. Power quality</p> <p>The electricity supply undertaking must agree on a schedule for determining emission limits with grid connection applicants.</p> <p>Generally, the plant owner must ensure that the wind power plant is designed, con-</p>

	<p>structured and configured in such a way that the specified emission limits are observed. The plant owner may purchase supplementary services from the electricity supply undertaking as agreed to ensure compliance with the specified limit values.</p> <p>4.1.2 Limit values</p> <p>The electricity supply undertaking is responsible for supplying limit values for the emission of the various types of disturbances coming from the wind power plant in the point of connection so as to ensure that the limit values for power quality in the public electricity supply grid are not exceeded. For wind power plants, which are connected far from other consumers, the limit values may, however, be changed to values above the normal limits following acceptance from the electricity supply undertaking.</p> <p>Could ENDK elaborate on the requirements to power quality, especially related to harmonics? This is to assess if there is a risk that additional harmonic filters need to be installed inside the WTGs.</p> <p>A: ENDK will issue harmonic voltage limits for all integer- and inter-harmonics ranging from the 2<sup>nd</sup> to the 50<sup>th</sup> harmonics. The limits are determined based on the available harmonic headroom at the PoC and takes into account the effect of the wind power plant (plant) on adjacent busbars.</p> <p>The limits are given as incremental limits in percent of the fundamental phase-to-ground voltage and includes the distortion caused by active injection from the plant as well as the potential increase in distortion caused by an interaction between the plant's and transmission system's harmonic impedances. Together with the limits, the harmonic background distortion and a grid impedance description in terms of impedance polygons in the frequency range of interest are provided by ENDK.</p> <p>In the same manner, limits for flicker are given.</p>
57	<p>What kind of supplementary services, related to harmonic filtering, are the electricity supply undertaking able to provide to ensure compliance with the specified limit values? And what is the price range</p> <p>A: No supplementary service is provided, as the power quality requirements specified in the TF 3.2.5 is addressing the Wind Power Plant – maximal emission as well as minimum immunity.</p>
58	<p>Our worries are mostly the possible difficulties in trading on the intraday market when we could have produced more according to later assumptions.</p> <p>Can you please specify how the rulings will be and also the balancing costs for the intraday trade?</p> <p>We regard the changes as a challenge versus the previous rulings, that only the TSOs are allowed to trade on the interconnector.</p> <p>A: The off-shore wind farm at Kriegers Flak will be an integrated part of the price area in Eastern Denmark in the day-ahead, intra-day and balancing markets. This means that the production and imbalances will be subject to the prices in this price area. There will be no limitations in terms of possibilities for trade in the day-ahead and intra-day markets, and the same conditions will apply in these markets as for any other Danish wind farm..</p>
59	<p>It is noted that on p.4 of the memo it is stated «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 connection towards Eastern Denmark.» We assume this mean that in such situations the KF operator will not be able to use the intraday market (as there is no grid capacity available) to balance its position if the wind farm experiences a higher than exempted production. Is this correct?</p> <p>A: No, this is not correct. There will be no limitations on the off-shore parks use of the</p>

	<p>intra-day market. The exemption in the balancing rules only applies to the option of netting imbalances with on-shore production facilities within the same BRPs portfolio. The off-shore wind park will have prioritized access to the grid and will therefore be able to sell all production in the day-head and intra-day markets in Eastern Denmark at all times.</p>
60	<p>Our understanding is further that in such cases energinet.dk will procure the necessary downward regulation in Germany. Is this correct? A: This is correct</p>
61	<p>We further assume that the KF wind farm will be liable for Eastern Denmark down regulation price and not the German down regulation price and that energinet.dk will be liable for any differences between these prices. Is this correct? A: No, this is not correct. The wind farm will be an integrated part of the price area in Eastern Denmark and will be subject to balancing prices in this area for both up- and down regulation.</p>
62	<p>How will access be arranged to the platform a) during construction and b) during operation (for regular maintenance, but also trouble shooting if required)? A: a) During construction onshore access to the site (yard) will be arranged by Energinet.dk as well as welfare and offices facilities for the Concession owners (WFO) personnel. Transport costs are not covered. b) WFO is responsible for all transport by boat or helicopter for the WFO staff.</p>
63	<p>Do you expect us to pay a rent fee for the used rooms, facilities? A: No, there will not be a rent fee for the use of the rooms appointed to the WFO</p>
64	<p>Can we use a fibre optic cable of your export cables for the wind farm data management? A: Yes there will be redundant fibre optic cable available on a commercial basis. Please see Appendix 6.1</p>
65	<p>What is the redundancy concept if one export cable or transformer is out of service (due to whatever reason)? For example, is the rating of the export cables higher than the nominal capacity of the substations? Or can other connected export cables be used? A: The 220 kV Cable system is laid out for 600 MW continues load. The two 220 kV Cables is to be operated in parallel.</p>