Hornsea Project Three
Offshore Wind Farm

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Appendix 25: Areas of agreement on the J6A data set analysis

Date: March 2019

Hornsea 3
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Front cover picture: Kite surfer near a UK offshore wind farm © Ørsted Hornsea Project Three (UK) Ltd., 2018.

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1. Introduction

1.1 This technical note documents the outcome of a meeting held between the Applicant and Spirit Energy on 13th March 2019 and a follow up telecom on the 20th March 2019, to discuss the criteria and methods used in the analysis of the J6A met data. Details are provided of the areas of agreement and method of analysis below. The meeting was constructive in aligning the two parties in the analysis of the dataset.

1.2 A revised quantification of the number of precluded days has been undertaken and an updated position is provided.

1.3 The total percentage of flights precluded by Hornsea Three as an annual average is presented by the Applicant and Spirit Energy.

2. Areas of agreement on the J6A data set analysis

Topic	Criteria required	Ørsted	Spirit Energy
		Agree or comment to be provided	**Agree or comment to be provided**
1. Flight restricted	1.1 sea state greater than or equal to 6 m SWH (significant wave height)	Agree	Agree
	1.2 and/or wind speed greater than or equal to 60 knots and gusts greater than or equal to 60 knots.	Agree	Agree
	1.3 Cloud base ≤200 ft day or ≤300 ft night	Agree	Agree
	1.4 Visibility <1500m	Agree	Agree
	1.5 Icing conditions. Surface temperature ≤4°C AND cloud base ≤ 1000 ft	Agree	Agree (and see 4.3 below) Operationally icing conditions are defined as: temperature below 0°C And visibility <100m And visible moisture in the air. Icing may thus occur when surface temperature is <=4°C and there is moisture in the air. This includes cloud (i.e. cloudbase<=1000') and precipitation or fog irrespective of cloudbase.
2. VMC +enroute descent	2.1 VMC Day: Cloud base greater than or equal to 600ft and Visibility greater than or equal to 4 km	Agree	Agree

	2.2 VMC Night: Cloud base greater than or equal to 1200ft and visibility greater than or equal to 5 km	Agree	Agree
3 VMC (shuttle)	3.1 VMC (shuttle) Day: Cloud base greater than 300 ft and visibility greater than or equal to 2km	Agree	Agree
	3.2 VMC (shuttle) Night: Cloud base greater than 500 ft and visibility greater than or equal to 5 km	Agree	Agree
4 IMC (ARA)	IMC conditions are defined as when it is not VMC 4.1 IMC (ARA) Day (not VMC day and cloud base greater than or equal to 300ft and visibility greater than or equal to 1.5 km)	Agree	Agree
	4.2 IMC (ARA only) night (not VMC night and cloud base greater than or equal to 400ft and visibility greater than or equal to1.5 km)	Agree	Agree
5 Flight restricted due to Hornsea Three	5 Wind direction.All take off and landings are assumed to be into wind	Agree	Agree

3. Method of analysis

Topic	Description of method	Ørsted	Spirit Energy
		Agree or comment to be provided	Agree or comment to be provided
Day	Duration of day	Ørsted have applied day as 06- 18:00 and 06-21:00 for June and July. It is difficult to consider the annual variance in sunrise/sunset with data in 3 hour periods.	Daylight taken as 30mins before sunrise to 30mins after sunset on each day. Night taken as from 30mins after sunset to 30mins before sunrise on each day.
Availability	Flight schedules	Ørsted have considered arrival and departure can occur at any time.	Spirit Energy have considered shift patterns. Crews will usually work an 06:00-18:00 shift. For the purposes of this analysis, a day is treated as available if

			flights are possible at 06:00 or 09:00 and 18:00 or alternatively at 06:00 and 15:00 or 18:00.
Corrupted data	Data rows removed that are corrupted	The corrupted rows have not been added but it has been agreed with Spirit Energy that due to the low number (10 in 2888) this is not significant.	Corrupted data rows corrected by re-importing raw data. The number of affected rows is small.
Duplicate data	Data rows ignored that are duplicate	Agree	Agree

4. Summary of findings

4.1 The Applicant and Spirit Energy had a consultation meeting on 13 March 2019 and a further telecom on the 20 March 2019 to align on the J6A data analysis.

4.2 The session was productive in that agreement was reached on the assumptions used for the purposes of the analysis (note Spirit Energy agreement to space requirements for manoeuvres is subject to validation by helicopter operators and simulator evaluation of pilot workload and environmental factors including turbulence). The analysis of frequency of occurrence of cloud base and visibility for types of flights available was in broad agreement. Spirit Energy has considered the spatial requirements for all manoeuvres, including take-off that would be carried out based on the weather conditions at each time in the met-ocean database and evaluated the impact on Spirit operations as a function of the proximity of the Hornsea Three array. For the purposes of the comparison a separation distance of 2.8 nm is applied which removes separation differences previously under discussion between the Applicant and Spirit Energy.

4.3 The main remaining differences have been identified to be due to the following factors:

- Spirit Energy have applied an additional test to the criteria applied and agreed at the meeting on 13th March 2019 to icing conditions which is that weather should also not be sunny and/or fair (i.e. no visible moisture).

Ørsted comments	Spirit Energy Comments
Icing conditions are defined as: temperature below ^{0}C And visibility <1000m And visible moisture in the air (Certification and operational definition). By setting the surface temperature to <=4C will capture ^{O}C at MSA. Setting the cloudbase to <=1000ft will capture visibility <1000m (i.e. in cloud) and visible moisture in the air as agreed by Spirit Energy and the Applicant. The Applicant is not aware how sunny or fair is defined for the J6A dataset or at what height. Sunny	For Icing conditions Spirit Energy are also applying a requirement that weather description does not include "Sunny" and/or "Fair". Icing does not occur in clear air. All other descriptors involve fog and/or precipitation.

or fair have no clear relation to icing conditions and could result in a reduction in the number of days lost at present.	

- Spirit Energy has assumed that crews work a 12 hour (day) shift and need to be able to spend at least 9-hours at the NUI before departing. The Applicant considered flights could take place at any time following the advice of Spirit Energy that the platform helidecks are being upgraded to permit night operations.

Ørsted comments	Spirit Energy Comments
The Applicant does not consider shift patterns can be realistically applied to the data set (considering the data is at 3-hour intervals). The data set is not sufficiently robust to calculate this with accuracy. The Applicant shall present calculations for both day and night separately.	Although day and night flights are possible, in order to assess the impact upon Spirit Energy operations (which is the purpose of the exercise) it is necessary to recognise that in order to conduct work on a NUI: 1. A flight to and from the NUI has to be possible near the start of the maintenance team's 12hr shift; and 2. A flight to and from the NUI has to be anticipated to be possible towards the end of the maintenance team's 12hr shift; and 3. A flight to and from the NUI has to actually be possible towards the end of the maintenance team's 12hr shift. It is recognised that 3hrly data does not resolve the transient nature of some weather such as passing fog patches or storms. Spirit's analysis therefore assumes that the flight taking personnel to the facility could be at 06:00 or 09:00 and the return flight could be at 15:00 or 18:00 where the first flight was at 06:00 or at 18:00 where the first flight was at 09:00. (Note some of these flights would not be in daylight)

- Spirit Energy has excluded no fly days in all percentage calculations (apart from % of no-fly days). Ørsted has not excluded no fly days.

Ørsted comments	Spirit Energy Comments
The Applicant has not excluded no fly days as the Applicant aims to present what is available now and what is available after the wind farm. The Applicant considers that if no fly days are excluded it reduces the size of the dataset, which means any future reduction in availability will have a larger effect.	The purpose of the analysis is to identify the impact of the windfarm. Days on which flights are already not possible should not be included as this situation is not changed by the presence of the windfarm.

5. Joint Position on number of precluded flights

5.1 The total percentage of time flights are precluded due to weather / icing restrictions (base case without Hornsea Three) as an annual average is presented in the table below. The Table also shows the total percentage of time flights are precluded due to the presence of Hornsea Three, and the total percentage of time flights are precluded due to the presence of Hornsea Three but would be precluded any way due the weather / icing restrictions.

5.2 With the nearest turbine at 2.8nm, the actual percentage increase in flight restrictions due to the presence of Hornsea Three is reported as 3.5 % by the Applicant 5% by Spirit Energy as presented in the Table below.

Fight restriction	Hornsea Three	Spirit Energy
Total percentage of time flights are precluded due to weather restrictions (base case without Hornsea Three)	8.6 %	3%
Increase in flight restrictions due to the presence of Hornsea Three	3.5 %	5%

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