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**Subject:** Spirit Energy ISH 1 Submission - Appendix Y [BRO-D.FID4510105]
**Date:** 14 December 2018 23:50:41
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SE ISH 1 - Appendix Y - AviateQ International Limited - Flight Evaluation Report Proposed Hornsea Three Offshore Wind Farm (October 2018)_44089257_1.PDF

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**CONFIDENTIAL MESSAGE - INTENDED RECIPIENT ONLY**

Please find attached Appendix Y

Kind regards


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# APPENDIX Y

# AVIATEQ INTERNATIONAL LIMITED REPORT (OCTOBER 2018)

# AviateQ International Limited

**CONFIDENTIAL**

# Proposed Hornsea Three Offshore Wind Farm

**Date:** October 2018

**By:** Alan Cuttler / Neil Mackay / Ray Reynolds

**Distribution:**

- Spirit Energy

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AVIATEQ INTERNATIONAL LIMITED, UK 31ST OCTOBER 2018

## TABLE OF CONTENTS

# 1 TERMS of REFERENCE and SCOPE

1.1 Spirit Energy contracted the services of AviateQ Intl. Ltd (AviateQ) to conduct a review of the proximity of the Ørsted (previously Dong) proposed Hornsea Project Three wind farm turbines to its offshore production facilities, the Chiswick, Grove and J6A platforms and determine whether, and the extent to which, the proposed distances would impact on helicopters operating to these facilities. AviateQ has reviewed Ørsted's Preliminary Impact Assessment, the DCO submission and attended one initial meeting with Dong in order to better understand the proposals and their potential impact. AviateQ also joined the 10th October meeting via Skype. This meeting, which reflects Ørsted's thinking subsequent to submission of the DCO and ES included discussion of several aspects of aviation and these are referenced in this report. In order to determine the potential impact, this review considered helicopter operations to the 3 platforms when carrying out Airborne Radar Approaches to the facilities in Instrument Meteorological Conditions and departures from the facilities in limited visibility and with a low cloud base. Consideration has also been given to low freezing levels and approaches in crosswind conditions.

# 2 ABBREVIATIONS & ACRONYMS

| | | | |
|---|---|---|---|
| AGL | Above Ground Level | METAR | Meteorological Aerodrome Report (Actual Weather) |
| AMSL | Above Mean Sea Level | MDA | Minimum Descent Altitude |
| AEO | All Engines Operating | MDH | Minimum Descent Height |
| ATC | Air Traffic Control | MSA | Minimum Safe Altitude |
| ARA | Airborne Radar Approach | MAP | Missed Approach Point |
| CAT | Commercial Air Transport | NATS | National Air Traffic Services |
| DH | Decision Height | NUI | Normally Unattended Installations |
| FL | Flight Level | | |
| fpm | Feet Per Minute | OAT | Outside Air Temperature |
| FSTD | Flight Simulation Training Device | PC2DLE | Performance Class 2 Defined Limited Exposure |
| GPS | Global Positioning System | PC2E | Performance Class 2 Enhanced |
| HCA | Helideck Certification Agency | SOP | Standard Operating Procedures |
| HMR | Helicopter Main Route | TDP | Take-off Decision Point |
| IOGP | Independent Oil & Gas Producers | VFR | Visual Flight Rules |
| IAS | Indicated Airspeed | VMC | Visual Meteorological Conditions |
| IFR | Instrument Flight Rules | Vtoss | Take-off safety speed |
| IMC | Instrument Meteorological Conditions | Vy | Best Rate of Climb Speed |
| LAT | Lowest Astronomical Tide | W/V | Wind Speed & Direction |

# 3 OVERVIEW

3.1 Orsted Hornsea Project Three (UK) Ltd. is proposing to develop an offshore wind farm, Hornsea Project Three, in the Southern North Sea. The project is anticipated to comprise up to 300 wind turbines in an area of approximately 696 square kilometres off the Norfolk coast (Environmental Statement (May 2018), Volume 1, Chapter 3, p. 2). The precise number and locations of the turbines has yet to be finalised. The maximum turbine blade tip height could be up to 325m above Lowest Astronomical Tide (LAT), although this would only apply to 160 or fewer turbines (Environmental Statement (May 2018), Volume 1, Chapter 3, p. 12). The exact positioning of the turbines was not included although Spirit Energy has advised that through their ongoing engagement with Ørsted, it is expected that turbines will be located along the eastern boundary of the Hornsea Project Three consent area.

3.2 The Eastern boundary of the proposed Hornsea Three project is in very close proximity to the already established Greater Markham Area of gas producing platforms operated by Spirit Energy, these platforms being served by helicopter services from Norwich in the UK and Den Helder in the Netherlands. The Greater Markham Area includes the Chiswick, Grove and J6A gas platforms.

3.3 The presence of wind turbines 1056 feet (325 metres) high with rotor diameters of 265 metres poses a hazard to aviation with concerns about obstacle clearance, turbulence and airspace constraints. The Chiswick platform is positioned a mere 1.5nm from the Eastern boundary of the proposed Hornsea Three array, the Grove platform 2.4nm and the J6A platform 6.9nm away.

3.4 The Chiswick and Grove platforms are Normally Unattended Installations (NUIs) but require regular visits by maintenance personnel approximately 40 times per year, the J6A platform is an accommodation platform accommodating up to 29 personnel. Access to all three platforms is required 24/7/365 for personnel transfer, medevac, urgent maintenance and evacuation reasons. Restrictions imposed on helicopter operations because of the proposed proximity of the Hornsea Three array would seriously jeopardise the ability of helicopter operators to provide this service when carrying out ARA's to a facility in IMC and when departing from a facility during periods of low visibility and low cloud base.

## 4 AVIATION CONSIDERATIONS

### 4.1 Standardisation

4.1.1 The use of repeatable standard approach profiles, tailored for specific helicopter types where required, enhances the ability of crews to monitor the approach and detect any deviations. Stabilised approaches and missed approach/go-around management in Instrument Flight Rules (IFR) and Visual Flight Rules (VFR) conditions, both day and night, when operating to offshore oil and gas installations are in place. Standardisation requires that the approaches are always flown the same way to the same gates and airspeeds regardless of the platform being approached and regardless of day or night operations. Missed approach profiles are also trained. Repeatability is the key. The North Sea is a hostile environment devoid of ground-based precision navigation aids. Standardisation, ensuring repeatable approach profiles and missed approaches are flown, is essential in this environment. At the missed approach point the helicopter would be at the height of the helideck plus 50 feet or at 200 feet, whichever is the higher. This missed approach manoeuvre consists of initiating a climbing turn (left or right) of >30° and not more than 45° and continuing the climb to MSA while ensuring any radar identified obstacles are avoided by at least 1 nm. While the normal maximum turn away should be 45°, if obstacles dictate making a larger turn, then this will increase the risk of pilot disorientation and by inhibiting the rate of climb, especially in the case of an OEI missed approach, may keep the aircraft at an extremely low level for longer than desirable. To intentionally place tall obstructions that would infringe the currently free airspace adjacent to existing offshore oil and gas facilities may result in pilots needing to exceed the 45° turn away which defeats the whole intent of standardisation and reduces safety margins to an extent that would not be acceptable for normal operations.

4.1.2 Standardisation in helicopter flight profiles when departing offshore elevated helidecks and the accuracy of the profiles flown are equally important especially in the event of an engine failure at rotation. In such an event the helicopter needs to be flown directly into wind to achieve Vtoss (take-off safety speed) and thereafter to achieve Vy (best rate of climb speed) to climb to at least 500 ft. An obstacle free environment is essential to minimise manoeuvring.

## 4.2 Visual & Instrument Meteorological Conditions

4.2.1 There are two meteorological conditions under which aircraft may operate, namely Instrument Meteorological Conditions and Visual Meteorological Conditions.

4.2.2 Visual Meteorological Conditions (VMC) are the meteorological conditions expressed in terms of visibility, distance from cloud horizontally and vertically equal to or better than specified minima under which an aircraft may be operated by visual reference. Instrument Meteorological Conditions (IMC) are conditions which are below the minima specified for VMC and require that the aircraft is operated by reference to flight instruments. Aircraft are operated either under Visual Flight Rules (VFR) or Instrument Flight Rules (IFR). General requirements in the oil and gas industry call for offshore Commercial Air Transport (CAT) flights to be planned and operated IFR.

4.2.3 When operating IFR, aircraft require a Minimum Safe Altitude (MSA) of 1,000ft height clearance above obstacles within 5nm of the aircraft. With the proposed Hornsea Three wind turbines being 1056ft high, the MSA under IFR would be 2056ft (nominally 2100ft).

## 4.3 Low Level Shuttles

4.3.1 Reference the Hornsea Project Three Consultation Meeting held in Aberdeen, 10/10/2018 Power Point presentation prepared by Ørsted.

4.3.2 Slide #26 poses the question *"In the event weather restrictions apply, can ARA be made to J6A with onward low level shuttle?"*

4.3.3 If the weather restrictions require an ARA to be made, then it is highly unlikely that a visual low-level shuttle to nearby platforms can be made. The Minimum Descent Altitude for a DAY ARA is 200 feet which is 300 feet lower than the minimum cloud base requirements for visual offshore shuttle flights. The Independent Oil and Gas Producers (IOGP) Aircraft Management Guidelines stipulate that night flights should only be flown using IFR procedures and minima, otherwise a VFR cloud base of 1000 feet and a visibility of 3nm is required. The Minimum Descent Altitude for a night ARA is 300 feet. Accordingly, we do not consider that Ørsted's proposed mitigation of operating an ARA approach to one platform and thereafter flying low level VFR between platforms would be practicable when IMC conditions prevail.

4.3.4 Weather minima shown in Table A below has been taken from the IOGP Aircraft Management Guidelines Version 2.

**Table A**

**IOGP VFR Operating Minima**

| Flight regime | Minimum operating height (a) | Cloud base (feet) | Visibility (NM) (b) | Requirements to fly given these VFR weather minima (c) |
|---|---|---|---|---|
| Offshore Helicopters – Day | 500 (b,d) | 600 | 3 (b,d) | |
| | 400 | 500 | 1/2 | Offshore helicopter inter field use only if visual contact is maintained with other facilities. |
| All Night Ops (d) | Night Flights should be flown using only IFR procedures and minima where available, otherwise the VFR minima should be a cloud base of 1000 feet with 100 feet of vertical cloud clearance and 3 NM visibility. | | | Twin-engine IFR certified aircraft with dual IFR/night current crew. All night flights should utilise IFR cockpit procedures for takeoffs and landings. |

**Note 1:**

a The minimum operating height refers to the height Above Ground Level (AGL) for overland flights, and the height Above Mean Sea Level (AMSL) for offshore flights.

b When lower minima are used, it is recommended that only twin-engine IFR certified aircraft with a dual pilot IFR current crew be used.

c VFR Flights may not depart or continue if the weather conditions at departure, en-route or the destination are below the above stated minimum.

d Minimum operating height for Day VFR with a ceiling less than 600 feet (but maintaining 100 feet of cloud clearance) and visibility to 2 NM may be allowed if the procedures are authorized by the NAA (National Aviation Authority)

**Note 2:**

Reference to Note 1 d) above and EASA Air Ops SPA.HOFO.130 Meteorological conditions - Minima for flying between offshore locations located in class G airspace the minimum operating height for Day VFR while maintaining 100 feet of cloud clearance equates to 400 feet.

## 4.4 Icing

4.4.1 A low freezing level will pose additional hazards for helicopters transiting the Hornsea Three area since helicopters operating in the Southern North Sea area are not fitted with de-icing equipment.

4.4.2 Reference the Hornsea Project Three Consultation Meeting held in Aberdeen, 10/10/2018 Power Point presentation.

4.4.3 Slide #11 Base Case scenario covers freezing levels and the MSA as follows. "*Helicopters will drop to as low as 500ft to shed ice and climb back to height.*"

4.4.4 Any helicopter having shed the ice would not climb back to height – into the very conditions that caused the ice in the first instance.

4.4.5 In order to drop to 500 feet under IFR, aircraft would need to be at least 1nm from the nearest turbine(s) and have at least a 2nm wide corridor that would enable them to continue their flight at such lower altitude. Accordingly, we consider that the current HMR 2 would not be suitable for use in conditions where there is icing potential at MSA. Re-routing HMR 2 around the windfarm would increase the distance from Norwich to the Chiswick platform by 5.3 nm; 10.6 nm for round trip. Such an increase would expose personnel to additional risk and may limit payloads necessitating additional flights.

## 4.5 Airspace

4.5.1 Reference the Hornsea Project Three Consultation Meeting held in Aberdeen, 10/10/2018 Power Point presentation.

4.5.2 Slide #25 included the statement "*Airspace in southern North Sea highly regulated to ensure safety of flight is not compromised (regulatory control and air traffic control (e.g. at airport departure and NATS en route services).*"

4.5.3 On a point of clarification on Slide #25 above and as stated in Annex 8.1 of the Preliminary Environmental Information Report, "*The Hornsea Three array area and offshore cable corridor are situated in an area of Class G uncontrolled airspace, which is established from the surface up to Flight Level (FL) 195 (approximately 19,500 ft.) and Class C controlled airspace, which is established above FL 195. Any aircraft can operate in this area of uncontrolled airspace without any mandatory requirement to be in communication with an ATC* *unit. Pilots of aircraft operating VFR (Visual Flight Rules) in Class G airspace are ultimately responsible for seeing and avoiding other aircraft and obstructions"*

4.5.4 Helicopters operating from the UK or Holland will be under NATS control and in communication with ATC until the change of flight watch to the destination or controlling oil and gas facility. It is anticipated that helicopters operating low level, including during the later stages of an ARA, will be masked by the proposed wind turbines.

## 5 METHODOLOGY

5.1 In order to accurately determine whether or not the distance from the proposed Hornsea Three wind farm turbines to the offshore production facilities, the Chiswick, Grove and J6A platforms would result in flight restrictions, a series of flight evaluations were carried out using a flight simulator. Actual, forecast and historical weather patterns were reviewed and applied.

## 6 FLIGHT SIMULATOR

6.1 Spirit currently contracts the AW139 and EC155B1 in support of its offshore operations. Due to the unavailability of an AW139 or an EC155B1 simulator at short notice, arrangements were made with Bristow Helicopters to use a full motion FRASCA EC225 Flight Simulation Training Device (FSTD) S/N 8017-00 located at the Bristow Training Centre, Aberdeen, Scotland. Technical Log No. 8287 dated 26/10/18 confirmed the simulator was fully serviceable. The AEO (All Engines Operating) and OEI (One Engine Inoperative) parameters were programmed into the simulator by Bristow's simulator engineers to accurately replicate the operation and flight profiles of these aircraft types. Key considerations were Vy (best rate of climb speed) and the rate of climb with all engines operating (AEO) and also with one engine inoperative (OEI) at maximum continuous power. These figures were obtained from the AW139 and EC155B1 Rotorcraft Flight Manuals. The Bristow Helicopters Chief Training Captain operated the simulator with technical support from the Bristow ECR Simulator & Facilities Manager and staff.

## 7 WEATHER REPORTS- J6A, Markham Field and Southern North Sea

7.1 The weather data used for the evaluation flight programme (Appendix 2) was obtained from three primary sources:

1) METAR (J6A Platform, source METAR NDAA ADD 26/10/18 at 07:55LT);
2) Superforecast J6-A Northsea Platform (Windfinder 26/10/18 at 03:21) and
3) Wind Statistics published by Windfinder.com.

7.2 Twelve evaluation flights were carried out to the three offshore helidecks with the weather selected for each of the flights based on METAR, forecast and wind statistics. These are referenced in the Flight Evaluation Result Tables.

7.3 The average prevailing wind for the year was 270/17kts. This information is in itself correct taken as an average over a period of 12 months but, at certain times of the year, the prevailing wind is from the East to North East. It cannot be assumed that an approach towards the west to avoid the wind turbine obstructions can always be achieved. Hence the requirement to be able to make an ARA approach from any direction.

## 8 FLIGHT SIMULATION SET UP: Platforms, Wind Farm Boundary & Wind Turbines

8.1 The latitude and longitude and helideck elevations of the production platforms taken from the HCA and Navtech plates were programmed into the simulator system software by Bristow:

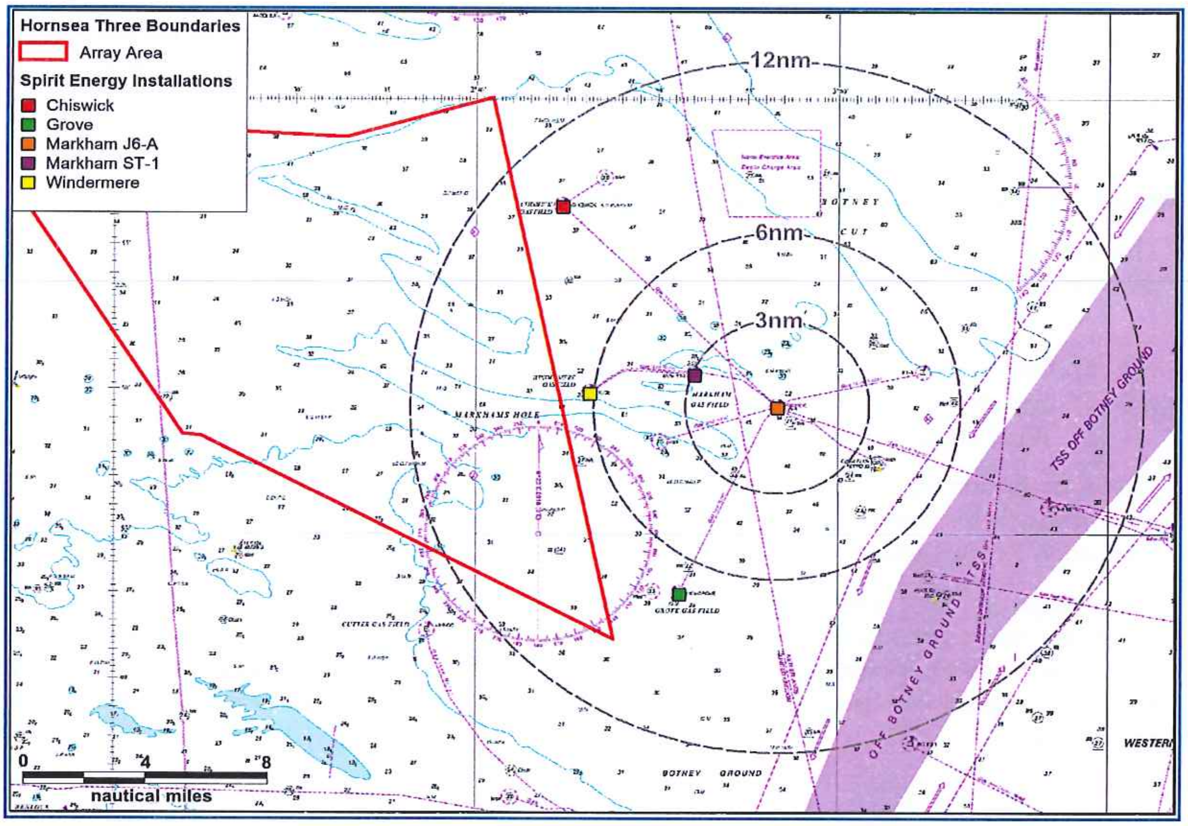
1. Chiswick : N53 56.4 – E002 44.83 with deck elevation 104ft.
2. Grove : N53 43.0 - E002 51.17 with deck elevation 85ft.
3. J6A : N53 49.4 - E002 56.6 with deck elevation 150 ft.

### 8.2 Wind Farm Boundary and Wind Turbines

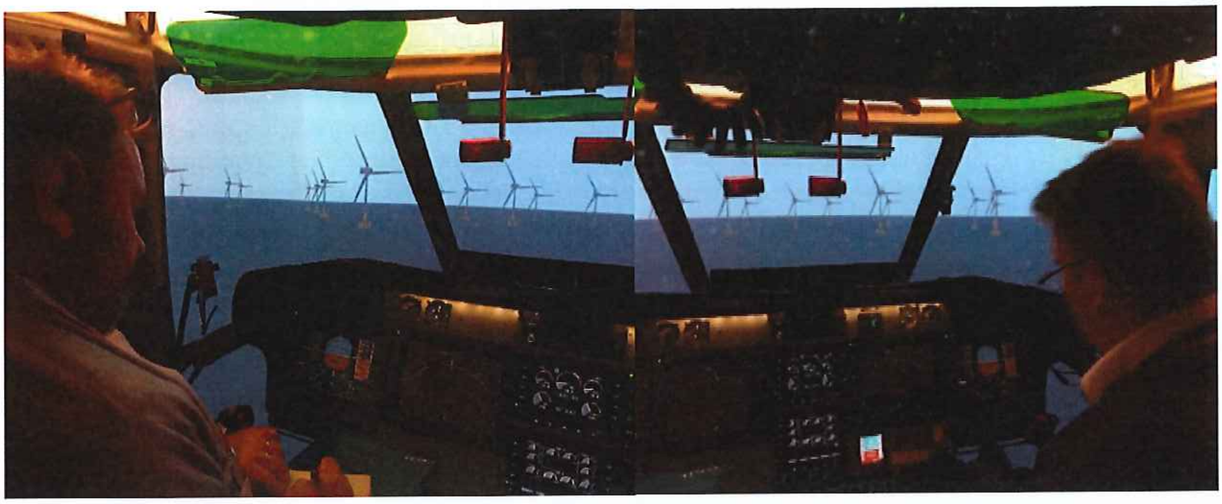
8.2.1 The position of the Hornsea Three wind farm eastern boundary was as given in Chapter 3, page 3 of the Environmental Statement. The positioning of the proposed wind turbines had not been identified in the Environmental Statement. Attempts were made by AviateQ to obtain relevant information from Ørsted but despite several phone calls and an e-mail nothing was forthcoming. In order to proceed against deadlines there was no alternative other than to plot the turbines (1,100 ft) into the simulator software along the eastern boundary. The resulting distances were as follows:

1. Chiswick platform 1.5 nm
2. Grove platform 2.4 nm
3. J6A platform 6.9 nm

8.2.2 The ST1 and the Windermere platforms were not included as these facilities are planned to be decommissioned prior to 2023.




**Platform positions Relative to the Proposed Boundaries**



**View from the simulator cockpit sitting on the helideck of the Chiswick Platform.**

## 9 FLIGHTS to CHISWICK, GROVE & J6A

9.1 Reference Figure 8.8, Section 8.11, Chapter 8.11.2 of the ES and Slide #15 in the Hornsea Project Three Consultation Meeting held in Aberdeen, 10/10/2018 Power Point presentation. These figures depict aviation flights within 9 nautical miles of Hornsea Three during October 2017. They do not show the point of origin or the point of termination of the flights with Slide #15 stating that *no flights shown to Chiswick platform, J6A platform or Grove platform from Norwich or Humberside.*

9.2 The information is one year old and not representative of current activity. Records provided by Spirit's current helicopter operator indicate that in 2018 up to the 22nd October 2018 there were 67 landings on the Chiswick platform from flights originating from Norwich and one to the J6A. The number of landings is quoted because the number of flights would be misleading due to multiple sector flights to Chiswick, Grove and J6A. In addition, these figures may not be representative of future demand as Spirit Energy may adjust the frequency of flights and subsequent landings in order to cater for increased or decreased demand. At the time of writing, for example, regular flights were being carried out for Spirit Energy to the Noble Hans Deul rig which was on project over the Chiswick location.

| **Humberside** | August | | September | | October 1st-22nd | |
|---|---|---|---|---|---|---|
| | AM | PM | AM | PM | AM | PM |
| Chiswick | 0 | 0 | 0 | 0 | 0 | 0 |
| Grove | 0 | 0 | 0 | 0 | 0 | 0 |
| J6A | 0 | 0 | 0 | 0 | 0 | 0 |
| **Norwich** | August | | September | | October 1st-22nd | |
| | AM | PM | AM | PM | AM | PM |
| Chiswick | 19 | 4 | 16 | 6 | 17 | 5 |
| Grove | 0 | 0 | 0 | 0 | 0 | 0 |
| J6A | 0 | 0 | 1 | 0 | 0 | 0 |
| **Den Helder** | August | | September | | October 1st-22nd | |
| | AM | PM | AM | PM | AM | PM |
| Chiswick | 11 | 12 | 9 | 4 | 12 | 8 |
| Grove | 14 | 13 | 11 | 11 | 8 | 8 |
| J6A | 21 | 23 | 20 | 18 | 17 | 14 |
| **Totals** | **65** | **52** | **57** | **39** | **54** | **35** |
| | **302** | | | | | |
| **Number of Helicopter Landings** | | | | | | |

# 10 FLIGHT EVALUATIONS

## 10.1 Flight Evaluation Programme Planning

10.1.2 The flight evaluation programme was developed by AviateQ International Limited in conjunction with Bristow Helicopters ECR Simulator & Facilities Manager and the Chief Training Captain for the EC225. The main considerations when planning the programme was that an Airborne Radar Approach (ARA) approach could be made into the prevailing wind and likewise when carrying out the missed approach procedure or departing a facility there would be no obstructions affecting the safety or operational efficiency of the aircraft. The planned aircraft weights were calculated based on PC2E and PC2DLE with 0.5 second exposure providing for the maximum payload, while at the same time complying with OEI requirements.

10.1.3 Twelve evaluation flights were planned, four flights to/from each of the three gas platforms, Chiswick, Grove and J6-A. With the three gas platforms and the windfarm programmed into the flight simulator, good visual recognition and orientation was provided.

## 10.2 Aircraft Types

10.2.1 The AW139 and the EC155B1 have different performance parameters which were programmed into the flight simulator. The AW139 being a more modern aircraft with higher engine performance delivers a greater OEI rate of climb. The OEI figures used were for maximum continuous power at Vy speed which would deliver the best rate of climb at PC2E and PC2DLE with 0.5 second exposure weights.

10.2.2 The figures shown in Table 1 below were entered into the flight simulator relevant to the evaluation flight exercise.

**Table 1. Aircraft Performance**
**Ref: AW139 Company Operations Manual and EC155B1 Rotorcraft Flight Manual**

| Aircraft Type | Performance Criteria | Weight-kg | Temperature | Airspeed Vy | OEI Rate of Climb-FPM |
|---|---|---|---|---|---|
| AW139 | PC2E | 6800 | +15 | 80kts | 620 |
| EC155B1 | PC2DLE (.5 sec) | 4750 | +15 | 75kts | 420 |

**AW139: Vy 80kts and ROC 620ft per minute**

## 10.3 Evaluation Flights - ARAs and OEI Departures

10.3.1 In Instrument Meteorological Conditions (IMC), Airborne Radar Approach (ARA) procedures are used to approach the platforms, relying upon on-board weather radar for obstacle detection and GPS for navigation. An extensive exercise involving 12 evaluation flights carrying out various approaches, missed approaches and departures, including with one engine inoperative (OEI), were completed. Seven of the flights were predicated on the EC155B1 flight parameters with five based on those of the AW139. The simulator was operated under the command of the Chief Training Captain supported by a second pilot and flight engineer recording the data.

**ARA to the Chiswick:**
**At 1.47nm approaching the Offset Point/Heading $270^{0}$/Speed 70kts/Altitude 200 feet.**

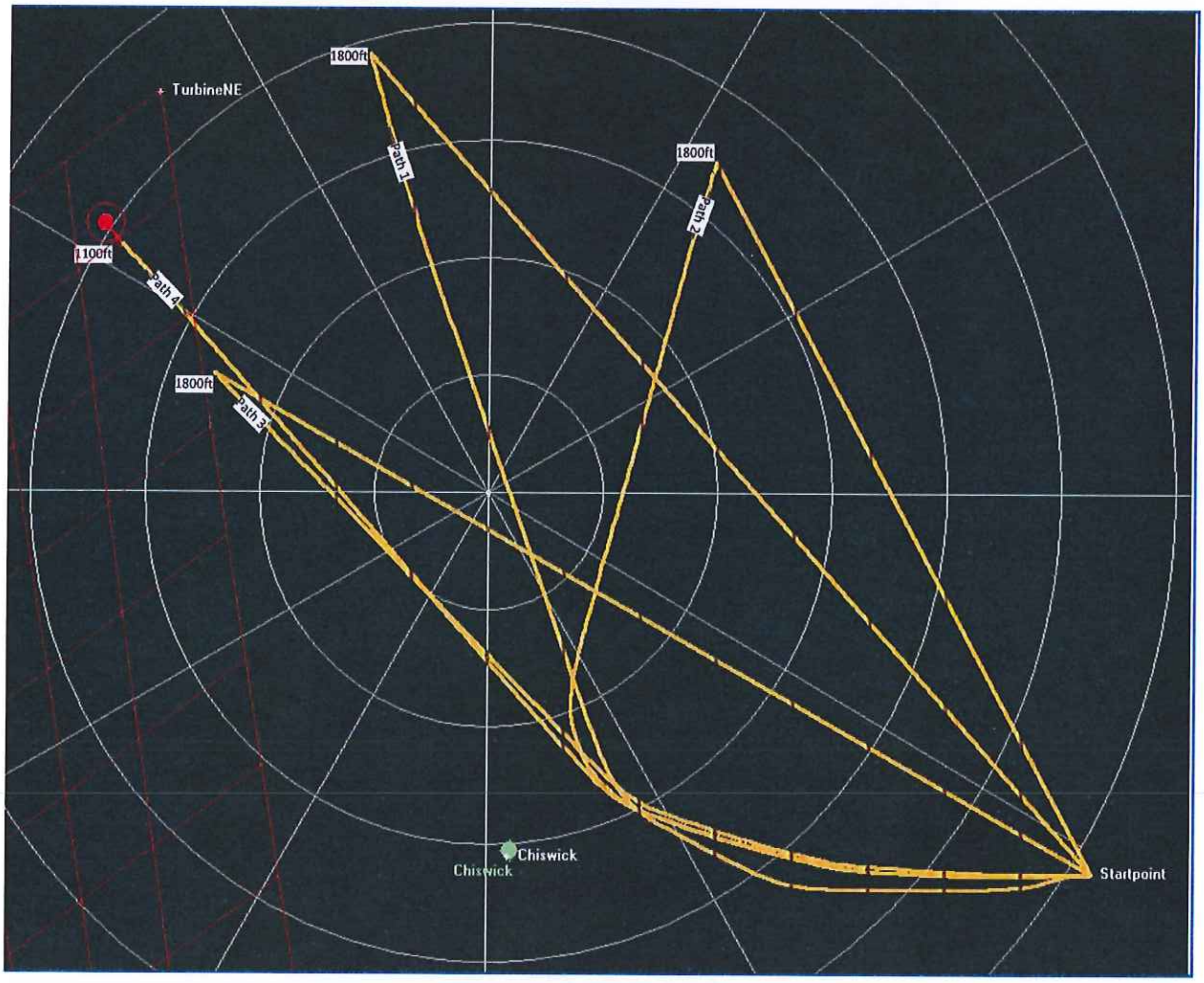
## 10.4 Generic ARA Approaches to the Chiswick – Plan Views

10.4.1 Prior to carrying out the detailed flight evaluations based on the performance characteristics of the AW139 and the EC155B1, four generic Airborne Radar Approaches (ARAs) were flown to the Chiswick. The objective of these flights was to ascertain the heading change required at the Missed Approach Point (MAP) to provide separation from the windfarm turbines.

10.4.2 A standard ARA was flown at an indicated airspeed of 80Kts on a final approach track of 270° in conditions of Nil wind. A right turn (10°) was carried out at the 1.5nm point with a second right turn (5°) at 1nm to ensure standard separation. Each go-around was initiated at the 0.75nm (MAP) using the go around (GA) mode to commence the climb at 1,000fpm for the first three ARAs and 500fpm for the fourth. Heading mode was used for the turn away using a standard Rate 1 turn. A decision height (DH) of 250ft was used throughout.

10.4.3 The four traces shown in the digital image below are based on the following:

Path 1: 45° go around heading change -1000fpm climb.
Path 2: 90° go around heading change -1000fpm climb.
Path 3: 30° go around heading change -1000fpm climb.
Path 4: 30° go around heading change -**500fpm climb**.




**Chiswick Platform ARA Approaches: Showing the four map traces in plan view**

- A 45° go around heading change with 1000fpm climb (Path 1) brings the aircraft to 1800 feet (i.e. below MSA) within 1 nautical mile of the turbines which is not permitted under IMC.

- With a 30° go around heading change and a 1000fpm climb (Path 3) the aircraft fails to reach MSA (2,100ft) before entering the turbine field.

- A 30° go around heading change with a 500fpm climb (Path 4) puts the aircraft well below turbine height on entering the turbine field.

- The above map traces clearly illustrate that the proposed windfarm is too close to the existing Chiswick platform to safely conduct an ARA on a westerly heading. A go around heading change of 90° (Path 2) is necessary to achieve a safe separation however, a 90° turn is not a Standard Operating Procedure.

10.4.3 Producing the map traces in plan view was very time consuming for the support engineers. In the time available the data for the AW139 and EC155B1 evaluation flights was recorded by the engineers and pilots and is presented in table format below.

## 10.5 Evaluation Flight Report Results – AW139 and EC155B1

10.5.1 The following colour coded tables provide an oversight of the results achieved during the evaluation flights to the Chiswick, Grove and J6A platforms. Green signifies that the aircraft can be operated clear of obstructions; red signifies the aircraft cannot be operated clear of obstructions and grey signifies not applicable.

**Table 2: Flight Evaluations**
**Chiswick Platform (1.5 nm from the Hornsea Three windfarm boundary)**

| Flight No. | Type of Exercise | Aircraft Type | Rate of Climb/ Descent Feet Per Minute | Indicated Airspeed (IAS in Kts) | W/V | PC2E/ PC2DLE Mass | Temp 0C | Altitude reached on crossing Eastern windfarm boundary | Distance from platform on reaching MSA or distance required to carry out an ARA | Note |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ARA missed approach at MAP OEI at max continuous. Average wind and temperature for the year taken from J6A | H155B1 | 420 | 75Kts | 270/17 | 4750 kg | 11 | 960 ft | 4.7 nm from platform | Non-Compliant – failed to achieve obstacle clearance requirements. |
| 2 | Crosswind Approach. ARA approach heading 180 degrees. See METAR 26/10/18 issued at 07:55. | H155B1 | N/A | 60Kts | 260/23 | 4750 kg | 10 | Exceeded drift angle limits | | ARA was not possible with a crosswind of 30°. Missed approach carried out at 1.5 nm |
| 3 | ARA approach from the West Forecast w/v and temp. for the J6A 27/10/18 issued at 1600hrs. See weather forecast Appendix 2. | AW139 | -1000ft minute to 1,000 feet followed by 500 ft minute down to 200 ft. | 60Kts | 063/22 | 6800 kg | 8 | N/A | 7 nm required for ARA | The ARA approach was commenced from 6 nm 2100 feet from the Chiswick Platform. Initial ROD 1000 FPM until 1000 feet and then reduced to 500 FPM. There was a 23 kts headwind and. the decent was started at 6 nm.<br>For an ARA approach towards the East it requires an unobstructed distance of 6.5 to 7 nm to allow time to complete the ARA approach. |
| 4 | Departure Chiswick, OEI at TDP max continuous power. | H155B1 | 420 | 75Kts | 270/17 | 4750 kg | 11 | 710 ft | 4.8 nm from platform | Non-Compliant – failed to achieve obstacle clearance requirements. |

**Flight Evaluation # 1.** During the missed approach there was insufficient distance to climb to MSA (2100ft) with the proposed development located at 1.45 nm from the Chiswick platform. The aircraft penetrated the windfarm area by 3.2 nm before reaching a safe altitude. The minimum distance for the missed approach would need to be 5 nm for the given wind conditions.

**Flight Evaluation # 2.** The maximum acceptable drift angle is 15°. A crosswind approach was carried out from the North on a heading of 180°. The actual weather at the time, 260° at 23kts and OAT of +11°C, was used. An approach speed of 60kts was maintained at an altitude 200 feet. At 1.5nm from the Chiswick platform the drift angle was 30° which was outside the SOP limits, resulting in a missed approach. Crosswind ARAs are not recommended in the offshore industry when the wind correction angle exceeds $15^0$ while IMC, primarily for two main reasons, namely the higher ground speed during the missed approach and the potential for pilot disorientation.

**Flight Evaluation # 3.** An ARA approach was flown towards the East using the forecast wind of 063° at 22kts. These conditions require a distance of 7nm to descend from the MSA (2100ft) to the minimum descent altitude of 200 feet to establish on finals no later than 2 nm from the Chiswick Platform. The descent and approach speed used was 1000ft per minute (fpm) and 60kts IAS until an altitude of 1000 feet and then reduced to 500 fpm to an altitude of 200ft. The speed and rate of descent on this approach needs to be managed but is still compliant with the published procedures. The requirement is 7nm clear of all obstructions to the destination landing point when carrying out an ARA approach towards the East. A stabilised approach flight configuration must be established at no later than 2nm from the landing destination.

**Flight Evaluation # 4.** After take-off and following an engine failure after TDP, there is insufficient distance to climb to MSA (2100ft) on one engine if the proposed windfarm is located 1.45 nm West of the Chiswick platform. The minimum distance for departure would need to be 5 nm for a departure into wind.

**Note:** An ARA approach to the East from the MSA (2100ft) requires a 7.5 nm clear sector to descend and establish on a 2nm final from Chiswick Platform at an altitude of 200ft.

**Table 3: Flight Evaluations**
**Grove Platform (2.4 nm from the Hornsea Three windfarm boundary)**

| Flight No. | Type of Exercise | Aircraft Type | Rate of Climb/ Descent Feet Per Minute | Indicated Airspeed (IAS in Kts) | W/V | PC2E/ PC2DLE Mass | Temp 0C | Altitude reached on crossing Eastern windfarm boundary | Distance from platform on reaching MSA or distance required to carry out an ARA | Note |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | ARA approach twin engine PC2E, J6A METAR 26/10/18 issued at 07:55. missed approach at MAP. | AW139 | 1000 | 80 Kts | 260/23 | 6800 kg | 10 | 2100 ft | 1.7 nm | Fully compliant twin engine operation only. |
| 6 | ARA missed approach at MAP OEI at max continuous. Average wind and temperature for October | H155B1 | 420 | 75 Kts | 270/18 | 4750 kg | 14 | 1900 ft | 5.2 nm | Non-Compliant – failed to achieve obstacle clearance requirements. |
| 7 | Departure Grove, standard departure OEI, PC2E, Average wind and temperature for the year. | AW139 | 620 | 80 Kts | 270/17 | 6800 kg | 11 | N/A | N/A | Turned onto a heading of 230⁰ (40⁰) turn at 500 feet prior to completing the Emergency Operations Procedures checklist in order to clear the windfarm to the south. |
| 8 | Departure Grove, OEI at TDP at max continuous power. | H155B1 | 420 | 75 Kts | 290/17 | 4750kg | 11 | 1700 ft | 4.6 nm | Non-Compliant – failed to achieve obstacle clearance requirements. |

**Flight Evaluation # 5.** When carrying out an ARA approach with all engines operating (AEO) there is sufficient distance from the Grove Platform to the proposed windfarm eastern boundary to make a climbing turn using terrain avoidance radar or a published GPS procedure. Notwithstanding, this adds an increased level of complexity to the departure procedures for which flight crew would need to be made aware and trained.

**Flight Evaluation # 6.** When conducting an ARA approach the recommended missed approach procedure is to climb straight ahead to MSA. In certain wind conditions, such as a wind from $250^0$ it would be possible to execute a left climbing turn away from the obstructions.

**Flight Evaluation # 7.** During the departure the main consideration was the proposed windfarm located 2.4 nm from Grove Platform. In order to remain clear of the windfarm a turn was initiated in the simulator at 500 feet but excluded executing the Emergency Operations Procedures check list.

**Flight Evaluation # 8. On** a single engine departure heading 290° there is insufficient distance to climb to MSA prior to over flying the windfarm: 420 ft per minute climb at Vy75 kts.

**Note:** An ARA approach to the East from the MSA (2100ft) requires a 7.5 nm clear sector to descend and establish on a 2nm final from Grove Platform at an altitude of 200ft.

| Table 4: Flight Evaluations J6-A Platform (6.9 nm from the Hornsea Three windfarm boundary) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Flight No. | Type of Exercise | Aircraft Type | Rate of Climb/ Descent Feet Per Minute | Indicated Airspeed. (IAS in Kts) | W/V | C2E/ PC2DLE Mass | Temp 0C | Altitude reached on crossing Eastern windfarm boundary | Distance from platform on reaching MSA or distance required to carry out an ARA | Note |
| 9 | ARA approach twin engine with missed approach at MAP. Average wind and temperature for the year taken from the J6A Platform. | AW139 | 1000 | 80 Kts | 270/17 | 6800 kg | 11 | 2100 ft | 1.7 nm | Fully compliant twin engine operation only. |
| 10 | ARA missed approach at MAP OEI at max continuous. Average wind and temperature for the year taken from the J6A Platform. | H155B1 | 420 | 75 Kts | 270/17 | 4750 kg | 11 | 2100 ft | 4.6 nm | Fully compliant twin engine operation only. |
| 11 | Departure J6A, standard departure OEI PC2DLE. Average wind and temperature for the year taken from the J6A Platform. | H155B1 | 420 | 75 Kts | 270/17 | 4750 kg | 11 | 2100 ft | 4.3 nm | Fully compliant twin engine operation only. |
| 12 | Departure J6A, OEI at TDP at max continuous power PC2E. Average wind and temperature for the year taken from the J6A Platform. | AW139 | 620 | 80 Kts | 270/17 | 6800 kg | 11 | 2100 ft | 2.9 nm | Fully compliant twin engine operation only. |

**Evaluation Flights # 9**. There were no obstructions within the 6.9 nm range of the J6-A platform with no limitations or restrictions for conducting an ARA to the J6-A Platform from all sectors other from the East which requires a minimum of 7.5 nm.

**Evaluation Flight # 10**. There were no obstructions within the 6.9 nm range of the J6-A platform with no limitations or restrictions for conducting an ARA to the J6-A Platform from all sectors other from the East which requires a minimum of 7.5 nm.

**Evaluation Flight # 11** There were no obstructions within the 6.9 nm range of the J6-A platform with no limitations or restrictions for conducting a departure from all sectors from the J6-A Platform.

**Evaluation Flight # 12**. There were no obstructions within the 6.9 nm range of the J6-A platform with no limitations or restrictions for conducting a departure from all sectors from the J6-A Platform.

**Note:** An ARA approach to the East from the MSA (2100ft) requires a 7.5 nm clear sector to descend and establish on a 2nm final from J6-A Platform at an altitude of 200ft.

## 11 CONCLUSION:

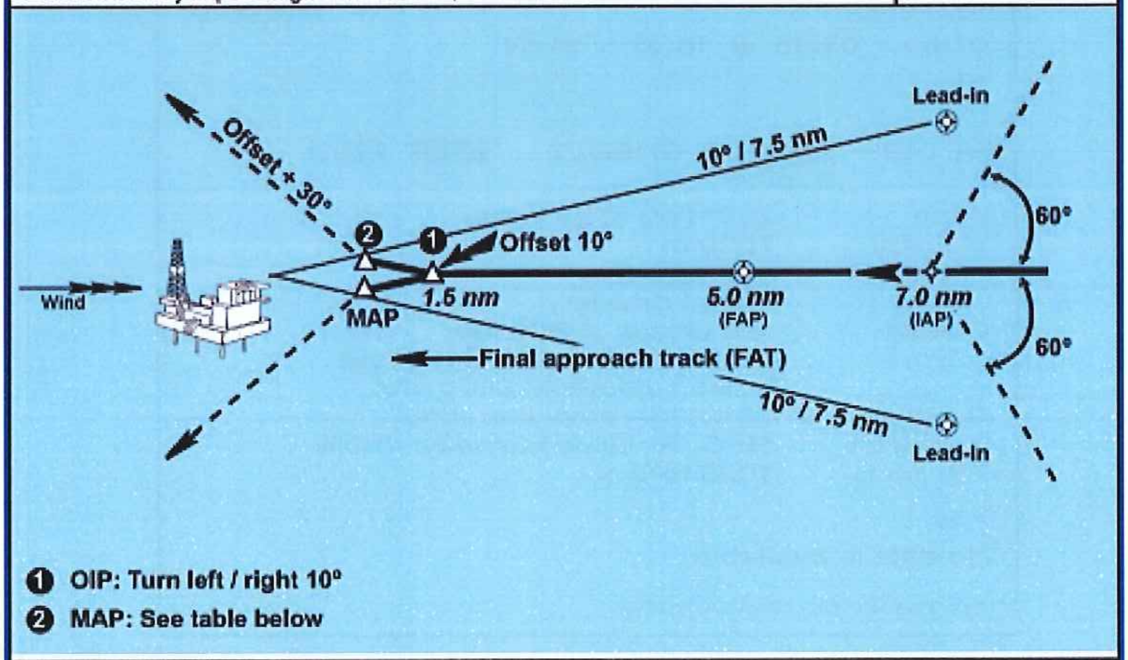
11.1 **A minimum distance of 7.5 nautical miles is required to safely execute an ARA into the Spirit Energy facilities. This is consistent with Ørsted's statement that "*If it is assumed that an acceptable rate of descent is a 3.5° glide path, the minimum distance that a 325 m high turbine can be constructed from a platform is 8 nm before instrument approach procedures have the potential to be restricted. The helicopter descends from the MSA at 8.4 nm avoiding all radar contacts by 1 nm but flying in any wind direction, to the Fixed Approach Point at 7nm (the procedural value set by the helicopter operator and ranging typically from 5 to 7 nm). The helicopter then flies a straight line approach (up to 30° out of wind in either direction) to a minimum descent height of 200 to 300 ft typically at 2 nm (CAA, 2016c). The helicopter then flies to the Missed Approach Point at 0.75 nm where a decision is made either to land or to fly past and conduct a Missed Approach*" and as depicted in the Ørsted ES, Volume 5, Annex 8.1, Fig 7.5, Indicative Instrument Approach Procedure with Turbines Present profile view.**

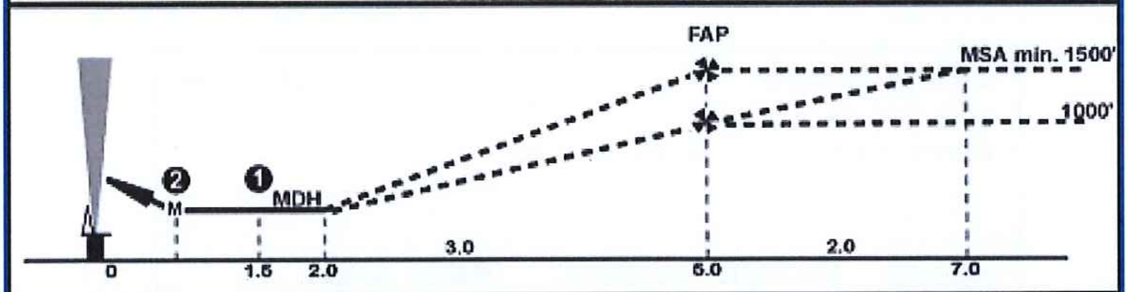
11.2 **A minimum distance of 5.0 nautical miles upwind is required in order to reach MSA following either executing a single engine missed approach at the ARA MAP, or on departure from the elevated helidecks with an engine failure at the point of rotation just after TDP.**

11.3 **The Ørsted reports and power point presentation did not take into consideration operations from an elevated helideck with an engine failure at the point of rotation just after TDP.**

## Appendix 1 - ARA Approach

| GPS | Final Apch Crs | Minimum Alt FAP | MDH | OIP +/-10° | Deck elev | MSA within 10 nm min 1500' |
|---|---|---|---|---|---|---|
| RNP 1.0 | Select | 1000' | See below | 1.5 nm | Check rig plate | |
| Missed approach: Initiate a climbing turn of minimum 30° in the same direction as the offset and continue climb to MSA. | | | | | | |
| a. No-RADALT MDA is 500 feet ASL<br>b. Reference radar to ensure approach and missed approach avoid any radar-identified obstacles by at least 1 nm<br>c. Customer may impose higher MDH limits; see OMC | | | | | | MSA offshore installation |




| Approach type | MDH Day | MDH Night | MAP Day | MAP Night | Notes |
|---|---|---|---|---|---|
| Radar approach minima | | | | | a. Or deck elevation plus 50', if greater |
| Straight-in (≤70 knots GS by 2 nm) | 200' (a) | 300' (a) | 0.75 nm | 0.75 nm | b. These limits also apply when the approach requires either manoeuvring to achieve into-wind landing, or short transit between approach destination and landing destination |
| Straight-in (71 to 90 knots GS by 2 nm) or circling (b) | 300' (a) | 500' | 1.0 nm | 1.5 nm | |

Example of an Offshore Airborne Radar Approach (ARA)

## Appendix 2 - Weather Details

### 2.1 METAR

The METAR obtained for the J6-A platform (26/10/18, 07:55 LT) was programmed into the simulator for evaluation Flight 2 and evaluation Flight 5.

**J6A platform** LT 08:04
NETHERLANDS UTC 06:04
07:59 ↗ 08:35 ☀ 18:27 ↘ 19:04

**METAR** 26/10/18, 07:55 LT AUTO MVFR
9 min

| | |
|---|---|
| Wind | 260° (W) at 23 knots |
| Visibility | 7000 m |
| Weather | showers rain<br>recent drizzle |
| Clouds | few clouds at 500 feet<br>scattered clouds at 1100 feet<br>broken clouds at 2400 feet |
| Temperature | 10°C, ISA deviation -5°C |
| Dewpoint | 10°C, Relative humidity: 100% |
| Pressure | 1005 hPa ↘ |

**TAF**
No data is available.

Source METAR: NOAA ADDS

**J6A platform** LT 17:26
NETHERLANDS UTC 15:26
08:01 ↗ 08:37 ☀ 18:25 ↘ 19:02

**METAR** 27/10/18, 16:55 LT AUTO VFR
31 min

| | |
|---|---|
| Wind | 030° (NNE) at 16 knots |
| Visibility | 10 km or more |
| Clouds | few clouds at 2400 feet<br>scattered clouds at 2900 feet |
| Temperature | 10°C, ISA deviation -5°C |
| Dewpoint | 2°C, Relative humidity: 57% |
| Pressure | 1011 hPa ↗ |

**TAF**
No data is available.

Source METAR: NOAA ADDS

## 2.2 Forecast Weather

Forecast weather report at the J6A Platform. The forecast weather (27/10/18 - 16:00. W/V 063/22 +8) used was from the Super forecast J6-A North Sea Platform.

**Superforecast J6-A Northsea Platform**

WINDFINDER

For reports, statistics and more on windfinder.com, scan this QR code:

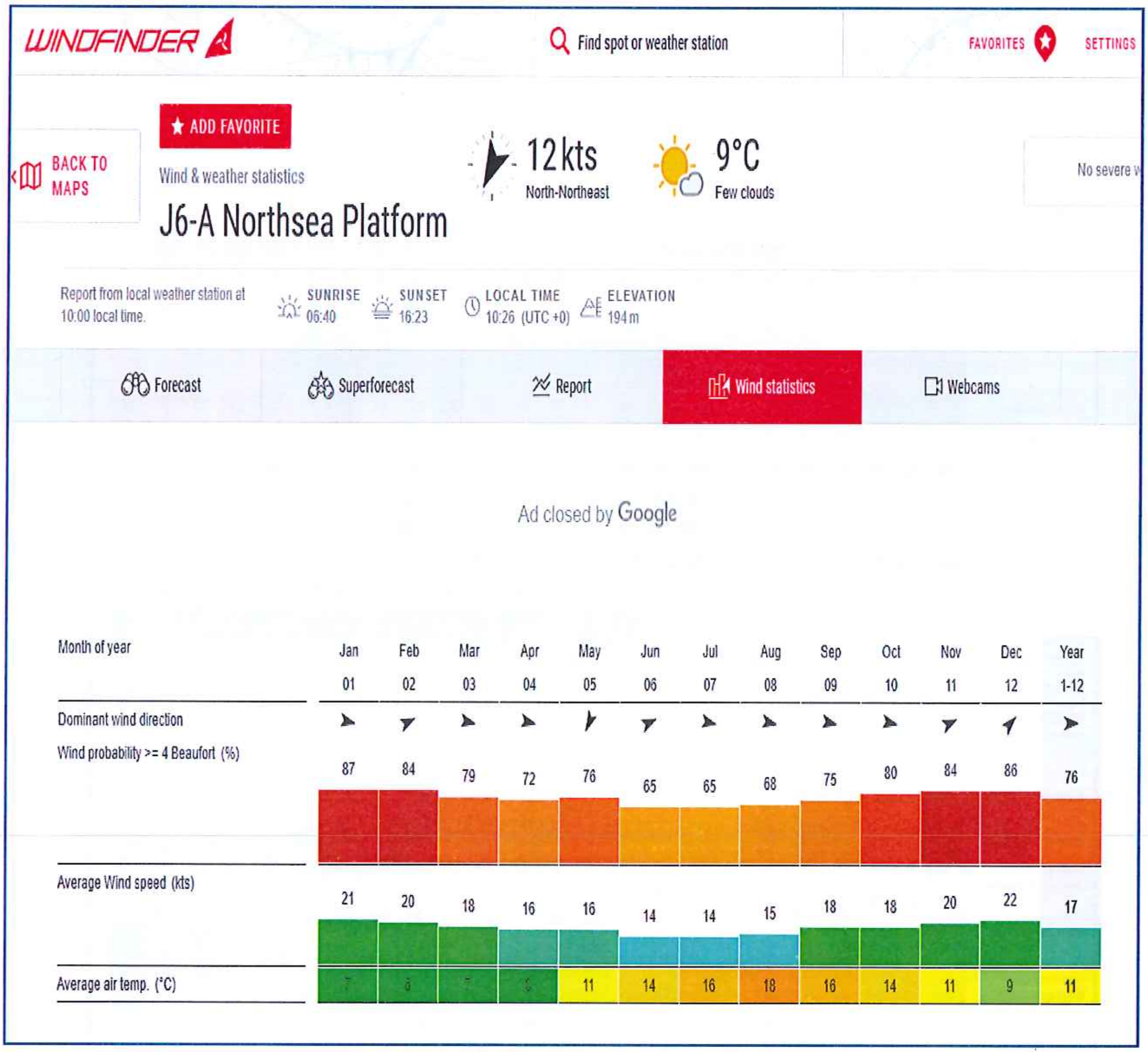
Time zone: UTC +1 | Sunrise: 07:36 | Sunset: 17:27
Last update: 03:21 local time

| Local date | Friday, Oct 26 | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Local time | 00h | 01h | 02h | 03h | 04h | 05h | 06h | 07h | 08h | 09h | 10h | 11h | 12h | 13h | 14h | 15h | 16h | 17h | 18h | 19h | 20h | 21h | 22h | 23h |
| Wind direction | | | | | | | | | | | | | | | | | | | | | | | | |
| Wind speed (kts) | 19 | 19 | 20 | 19 | 19 | 20 | 20 | 21 | 18 | 21 | 22 | 23 | 24 | 24 | 23 | 24 | 24 | 22 | 22 | 32 | 31 | 25 | 30 | 31 |
| Wind gusts (kts) | 22 | 22 | 22 | 21 | 19 | 20 | 20 | 22 | 21 | 23 | 24 | 25 | 24 | 25 | 25 | 27 | 26 | 23 | 25 | 38 | 33 | 31 | 34 | 38 |
| Cloud cover | | | | | | | | | | | | | | | | | | | | | | | | |
| Relative humidity (%) | 88 | 88 | 88 | 89 | 86 | 87 | 87 | 88 | 86 | 80 | 77 | 76 | 78 | 79 | 85 | 88 | 73 | 77 | 83 | 89 | 79 | 76 | 80 | 88 |
| Precipitation (mm/h) | | | | | | | | 0.6 | 0.1 | 1.2 | | | | | | 0.2 | 3.1 | | 0.1 | 0.4 | 0.1 | | 0.9 | 0.3 |
| Precipitation type | | | | | | | | | | | | | | | | | | | | | | | | |
| Air pressure (hPa) | 986 | 985 | 984 | 983 | 982 | 981 | 981 | 980 | 979 | 979 | 978 | 978 | 978 | 978 | 977 | 977 | 977 | 976 | 976 | 976 | 977 | 978 | 978 | 979 |
| Air temperature (°C) | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 8 | 7 | 9 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Feels like (°C) | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | | | | | | | | | | | | | | | |
| Wave direction | | | | | | | | | | | | | | | | | | | | | | | | |
| Wave height (m) | 1.7 | 1.8 | 1.8 | 1.8 | 1.9 | 1.9 | 2.0 | 2.0 | 2.0 | 2.1 | 2.2 | 2.2 | 2.2 | 2.3 | 2.3 | 2.3 | 2.3 | 2.4 | 2.6 | 2.7 | 2.9 | 3.1 | 3.3 | 3.4 |
| Wave period (s) | 8 | 8 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 8 | 8 |

| Local date | Saturday, Oct 27 | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Local time | 00h | 01h | 02h | 03h | 04h | 05h | 06h | 07h | 08h | 09h | 10h | 11h | 12h | 13h | 14h | 15h | 16h | 17h | 18h | 19h | 20h | 21h | 22h | 23h |
| Wind direction | | | | | | | | | | | | | | | | | | | | | | | | |
| Wind speed (kts) | 29 | 27 | 28 | 26 | 24 | 27 | 20 | 24 | 32 | 27 | 20 | 20 | 12 | 16 | 17 | 21 | 22 | 23 | 24 | 24 | 24 | 24 | 23 | 22 |
| Wind gusts (kts) | 34 | 31 | 29 | 28 | 29 | 27 | 26 | 34 | 33 | 34 | 23 | 23 | 15 | 18 | 18 | 21 | 23 | 23 | 25 | 26 | 26 | 26 | 24 | 23 |
| Cloud cover | | | | | | | | | | | | | | | | | | | | | | | | |
| Relative humidity (%) | 82 | 77 | 77 | 86 | 77 | 82 | 89 | 99 | 84 | 91 | 81 | 81 | 79 | 76 | 71 | 73 | 74 | 74 | 77 | 72 | 70 | 70 | 70 | 71 |
| Precipitation (mm/h) | 0.1 | 0.3 | 0.1 | 0.2 | 0.5 | 0.5 | 0.1 | 1.8 | 6.5 | 4.3 | 2.4 | 2.4 | 0.4 | 0.1 | | 0.1 | 0.6 | | 0.1 | | | | | |
| Precipitation type | | | | | | | | | | | | | | | | | | | | | | | | |
| Air pressure (hPa) | 979 | 979 | 979 | 980 | 979 | 979 | 979 | 980 | 979 | 980 | 981 | 981 | 982 | 982 | 983 | 984 | 985 | 985 | 986 | 988 | 989 | 990 | 991 | 992 |
| Air temperature (°C) | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 4 | 8 | 7 | 8 | 8 | 8 | 8 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Feels like (°C) | | | | | | | | | | | | | | | | | | | | | | | | |
| Wave direction | | | | | | | | | | | | | | | | | | | | | | | | |
| Wave height (m) | 3.5 | 3.5 | 3.5 | 3.4 | 3.4 | 3.3 | 3.2 | 3.2 | 3.2 | 3.1 | 3.1 | 3.1 | 3.0 | 2.9 | 2.8 | 2.7 | 2.7 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.5 |
| Wave period (s) | 8 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 7 |

## 2.3 Wind Statistics

The wind statistics for the J6-A are reported on www.windfinder.com.




| Month of year | Jan 01 | Feb 02 | Mar 03 | Apr 04 | May 05 | Jun 06 | Jul 07 | Aug 08 | Sep 09 | Oct 10 | Nov 11 | Dec 12 | Year 1-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dominant wind direction | | | | | | | | | | | | | |
| Wind probability >= 4 Beaufort (%) | 87 | 84 | 79 | 72 | 76 | 65 | 65 | 68 | 75 | 80 | 84 | 86 | 76 |
| Average Wind speed (kts) | 21 | 20 | 18 | 16 | 16 | 14 | 14 | 15 | 18 | 18 | 20 | 22 | 17 |
| Average air temp. (°C) | 7 | 6 | 7 | 8 | 11 | 14 | 16 | 18 | 16 | 14 | 11 | 9 | 11 |

## Reference Documents:

| Document | Reference |
|---|---|
| **EASA Air Ops** | Annex V – Part-SPA - SPA.HOFO<br>– SPA.HOFO.125 Airborne radar approaches (ARAs) to offshore locations — CAT operations<br>– AMC1 SPA.HOFO.125 Airborne radar approach (ARA) to offshore locations |
| **IOGP AMG** | Independent Oil and Gas Producers (IOGP) Aircraft Management Guidelines 1.7.3.2 Visual Flight Rules (VFR) Table 2: VFR weather minima |
| **Aircraft Operators Operations Manuals** | 8.3 FLIGHT PROCEDURES - 8.3.1 VFR/IFR Policy |
| | 8.4.4 Offshore instrument approaches - Wind correction angle (WCA) exceeding 15° while IMC |

**End of Report**