Dublin Array
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EIAR Volume 4: Offshore Infrastructure Technical Appendices Appendix 4.3.12-2 The Potential Impact of the Dublin Array on Helicopter Ops

Kish Offshore Wind Ltd

RWE SLR GoBe APEM Group

www.dublinarray-marineplanning.ie

The Potential Impact of the Dublin Array on Helicopter Operations to the Kish Tower – Helicopter One Engine Inoperative Case

Prepared by	Anatec Limited
Presented to	Kish Offshore Wind Limited and Bray Offshore Wind Limited
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	Aberdeen Office	Cambridge Office
Address	10 Exchange Street, Aberdeen, AB11 6PH, UK	Braemoor, No. 4 The Warren, Witchford Ely, Cambs, CB6 2HN, UK
Tel	01224 253700	01353 661200
Fax	0709 2367306	0709 2367306
Email	aberdeen@anatec.com	cambs@anatec.com

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Revision Number	Date	Summary of Change
00	31 Jan 2020	Initial Draft
01	11 June 2020	Update to include turbine layout
02	21 February 2024	Review
Final	20 April 2024	Final for submission

Contents

Abbreviations Table

Abbreviation	Definition
AIS	Automatic Identification System
AMSL	Above Mean Sea Level
CAP	Civil Aviation Publication (UK CAA Guidance Document)
CAT	Commercial Air Transport (Regulations)
EASA	European Aviation Safety Agency
HESLO	Helicopter External Sling Load Operations
HHO	Heli-Hoist Operations
HOFO	Helicopter Offshore Operations
IAA	Irish Aviation Authority
IFR	Instrument Flight Rules
OEI	One Engine Inoperative
SPA	Special Approval
SPO	Specialised Operations
TAS	True Airspeed
VFR	Visual Flight Rules
WTG	Wind Turbine Generator

1 Introduction

Anatec has been tasked with identifying a mechanism to assess the potential impact from the presence of Wind Turbine Generators (WTG) and offshore substation platform on helicopter operations to the Kish Tower, also known as the Kish Bank Lighthouse. The current helicopter operator, PDG Aviation Services, provides an EC 135 helicopter under contract to the Commissioner of Irish Lights.

A meeting between the Applicant, PDG Aviation Services and an Anatec representative was held on the 8th January 2020 in the PDG facility at Cumbernauld Airport. The meeting confirmed the earlier assumptions made regarding the type of operation, in particular that it was conducted under day Visual Flight Rules (VFR). Both the Commissioner of Irish Lights and PDG were contacted in January 2024 to confirm their position had not changed. The response received from PDG on the 27th January 2024 raised no concerns about helicopter access to the Kish Tower.

The Kish Tower has a helipad which is used when flying personnel and supplies to the lighthouse for routine maintenance and refurbishment, as well as emergency repairs. Sufficient space has to be provided between the wind farm structures and the lighthouse for safe helicopter operations under VFR.

This document identifies the distances required between the Kish Tower helipad and the closest set of WTG, especially for the most adverse condition, which is an engine failure following a take-off heading towards the wind farm. PDG provided a One Engine Inoperative (OEI) climb performance graph which was used to calculate the minimum distance required between the Kish Tower helipad and the closest turbine. The initial assessment was then updated to take account of the location and layout of the WTGS closest to the Kish Tower and how they influence the take-off paths available.

This work has been conducted by Mark Prior, an independent aviation consultant with over 40 years of helicopter experience,. This experience includes offshore operational flying, experimental flight test and as a member of regulatory and research working groups.

2 Calculation of the Distance Required Between the Kish Tower Helipad and the Closest Turbines

Following the extremely unlikely event of an engine failure during take-off or the final stages of an approach, a climb in a straight line, to a safe height, has to be made by the helicopter. It is assumed that a safe height is 500 ft Above Mean Sea Level (AMSL) for VFR operations. Following the climb, a turn away from any obstacle will be made.

PDG Aviation supplied the OEI climb graph for the EC135T2+ at the 2-minute power rating; EC135 T2+ Rotorcraft Flight Manual Graph 5-61 shown in Figure 1 (as provided by PDG). This graph was used to determine the rate of climb at the best climb speed, and hence the longitudinal distance required to climb to a safe height.

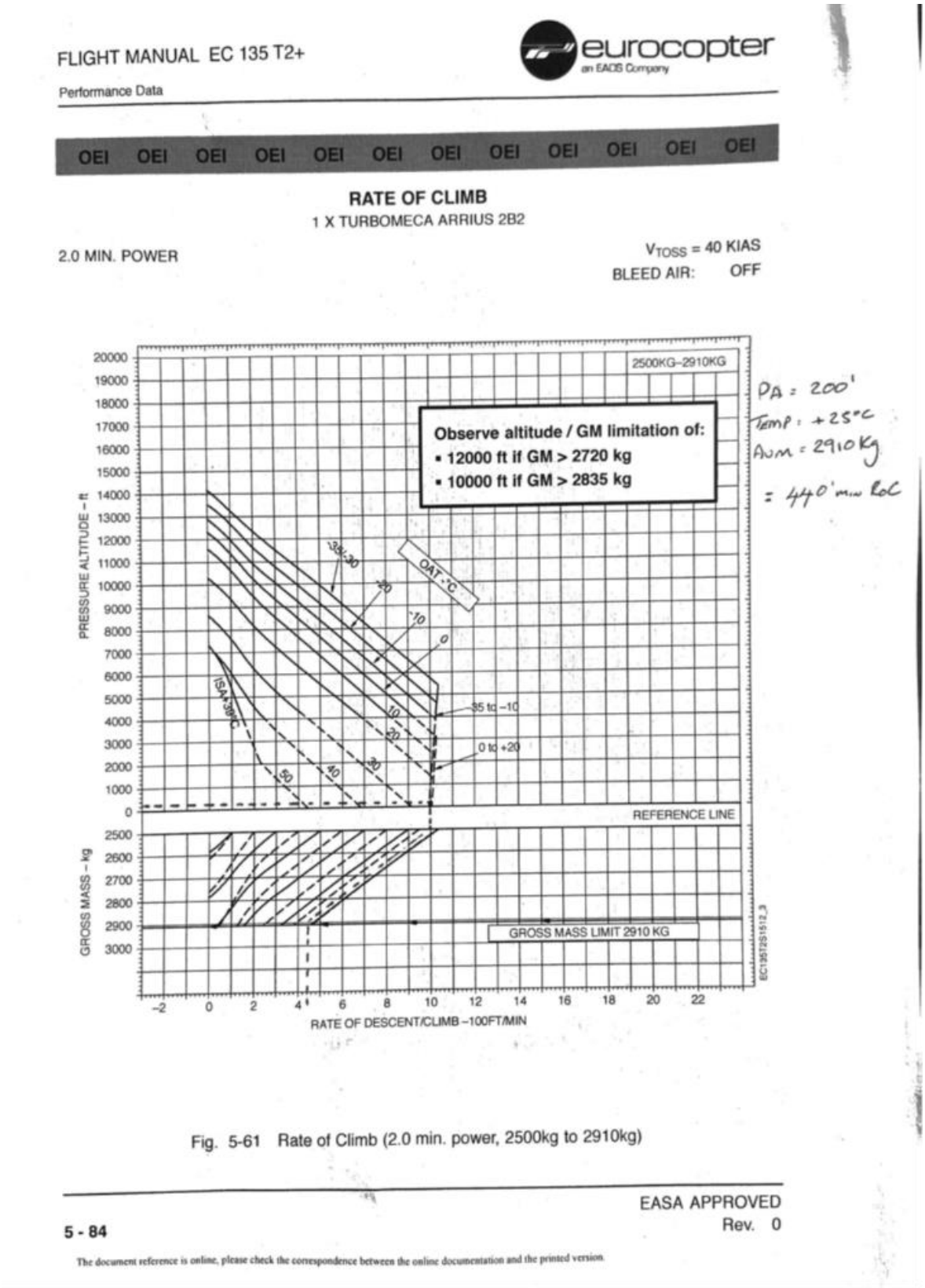

Figure 1 EC135 T2+ OEI Climb Graph at 2 Minute Power Rating

2.1 Vertical Distance Required

Height of the Kish Tower helipad – 31 m ≈ 100 ft

Therefore, a further climb of 400 ft has to be made to achieve 500 ft AMSL before a turn away from obstacles can be made. Table 1 shows the following rates of climb at 40 knots (kt) airspeed.

2.1.1 Conditions Assessed

- Temperature: 25°C
- Pressure altitude: 200 ft AMSL
- Take-off Safety Speed (Vtoss):40 kt airspeed
- Under the conditions assessed, the following minimum rates of climb would be achieved at the values of aircraft mass shown.

Table 1 Rate of Climb OEI for Various Mass Conditions

Helicopter Mass (kg)	Rate of Climb (ft/minute)
2700	700
2800	600
2910 (maximum)	440

The worst-case flight condition would be a climb at the maximum mass of 2910 kg, giving a rate of climb of 440 ft/min at an airspeed of 40 kt.

2.2 Horizontal Distance Required

It can be assumed that the wind strength would be at least 10 kt, as a light wind would permit a take-off direction which would not be pointing directly at the wind farm. With a headwind of ≥10 kt, the groundspeed would be ≤30 kt. For this worst-case assessment, a ground speed of 30 kt will be assumed (40kt Vtoss minus 10 kt headwind).

A climb of 400 ft at a rate of climb of 440 ft/min will take 55 seconds. Fifty-five seconds at a groundspeed of 30 kt will cover a lateral distance of 0.45 nm (833 m)

2.3 Turn Away from Obstacles After Reaching 500 ft AMSL

A turn away from the windfarm through 90° at 40 kt airspeed can be calculated.

Classic aerodynamic theory shows that:

$r = V^2/(g \tan Ø)$

Where:
r = radius of turn (m)
g = 9.81 m/s^2
V = True Airspeed (TAS) (converted from kt to m/sec). For helicopters operating at low level in temperate climates TAS ≈Indicated Airspeed
Ø =Angle of bank (°)

For a turn at 40 kt (20.56 m/s) airspeed, using 10° of bank, the radius of turn would be

$r = 20.56^2/(9.81 \times 0.17)$

r = 253 m = 0.13 nm

Therefore, the total distance required will be 0.45 nm+ 0.13 nm = 0.58 nm (1074 m)

Under VFR a minimum vertical and lateral separation of 500 ft (152 m or 0.08 nm) has to be maintained between the aircraft and structures.

This gives a total lateral distance required under the current aviation regulations of 1222 m

(0.45 nm+0.13 nm+0.08 nm = 0.66 nm or 1222 m).

The distance of 1222 m can be considered precautionary given:

- An engine failure at deck height can be regarded as remote. Operations under EASA HOFO Regulations require the probability of an engine failure in the 9 seconds before landing or take-off to be ≤ 5×10^{-8} . An engine failure higher than deck height will require a reduced vertical distance at the limited OEI rating, therefore less time to reach 500 ft and a reduced lateral distance required.
- The Flight Manual graph (Figure 1) uses Minimum Guaranteed Power, i.e. the point at which the engines are rejected and sent for overhaul. Normally more power will be available and so the rate of climb will be slightly in excess of the figures shown.

- It is assumed that the EC135 will take-off at the maximum mass of 2910 kg. Under many conditions the mass will be lower and so a greater rate of climb can be achieved. For example, at 2700 kg only 916 m will be required to climb to 500 ft, turn away from the array with a 500 ft lateral separation.
- A headwind of 10 kt was assumed. A higher headwind will reduce the lateral distance required. For example, at 2910 kg and 30 kt of wind, the total lateral distance required will be 677 m.

2.4 Turbulence

Turbines will create turbulence but this will be proportional to the strength of the wind. In strong wind conditions, such as the case quoted above with 30 kt of headwind, the horizontal distance required to climb to 500 ft will be reduced and so the separation between the helicopter and the obstacles will be increased, reducing the effect of turbulence on the helicopter. Using a nominal distance between the Kish Tower and the closest turbine of 1320 m, an OEI climb to 500 ft into a 30 kt wind, and turn away from the array, will result in a separation distance of:

1320 m – 525 m = 795 m.

Note: 525 m is the distance of 677 m calculated above minus the 152 m already included as the minimum separation distance from obstacles.

3 Safe Take-Off Path

This section considers the 50 WTG layout given that it includes a location (WTG) at the closest distance to the Kish Tower and therefore provides for a precautionary assessment.

The calculations shown in Section 2 assume that the WTGs form an impenetrable barrier which cannot be breached. However, as shown in Figure 2, the WTGs are widely dispersed and so an unobstructed take-off path is available for the vast majority of take-off conditions.

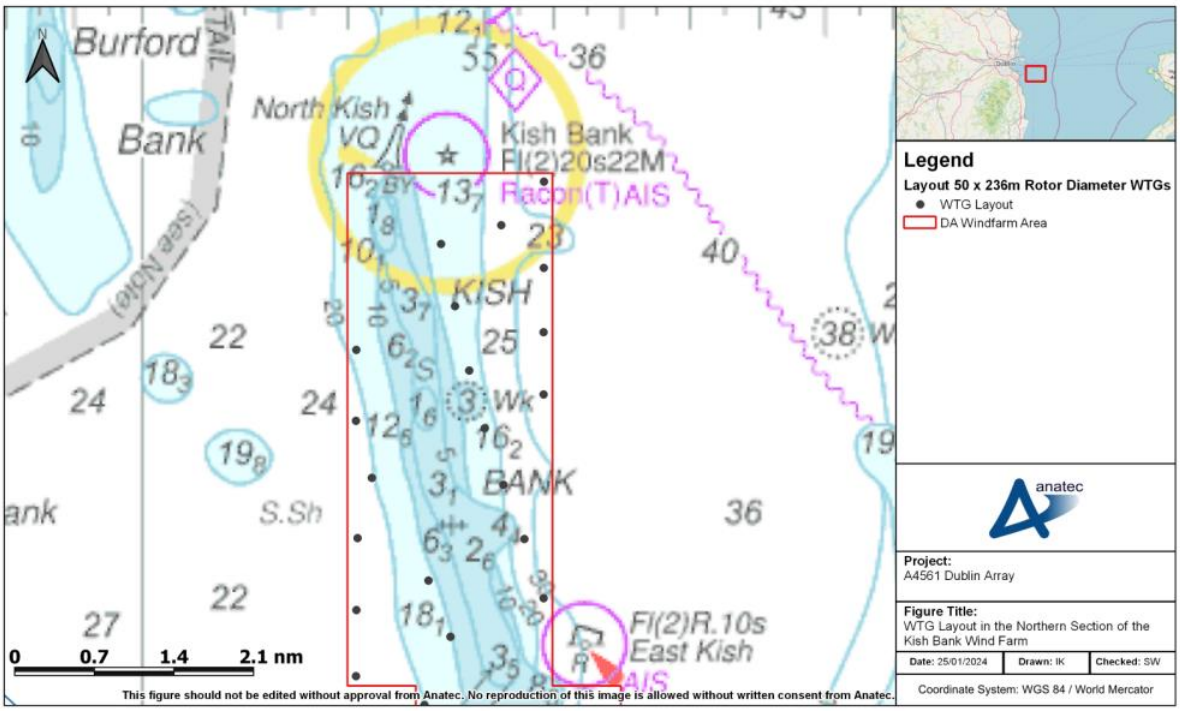

Figure 2 50 WTG Layout in the Northern Section of the Kish Bank Wind Farm

A take-off arc unobstructed by any WTGs is available from approximately 255° through North to approximately 100°, which would be available for winds from those directions. Also, this unobstructed arc could be utilised when the wind was calm. For other wind directions, a number of large take-off arcs are available in southerly, south easterly and south westerly directions. The available distance between the Kish Tower and the closest WTG would still allow sufficient space for an OEI climb to a safe height, before a small deviation in track to follow a clear lane to the south for several miles. Even when the wind direction is aligned exactly with the closest southerly WTG, a small deviation of circa 10° either side of track towards the WTG would result in a safe take-off path both under OEI conditions and a standard take-off. The WTG layout identified shown in Figure 2 will have no major operational impact on day VFR operations to the Kish Tower helipad. Alternative layouts with 39 and 45 WTGs would also have no major operational impacts as the distances between the Kish tower and the closest WTG in these layouts are greater than the 50 WTG layout assessed here.

4 Summary

4.1 Engine Failure on Take-Off

In preparing this report, account was taken of the EOI performance characteristics of the EC 135 helicopter, using the graph provide by PDG Helicopters and shown in Figure 1. Under worst case flight conditions of a high aircraft mass, light winds, high temperature and minimum guaranteed engine power, 1222m was sufficient to climb to 500 ft and then make a 90 degree turn away from an obstruction.

4.2 Available Take-Off Arcs

The turbine layout identified in Figure 2 shows that there are a number of large take-off arcs available which cover all major wind directions. In the event of the wind flowing from the closest WTG, located south of the Kish Tower, a small deviation in the take-off flight path of circa 10° would be sufficient to provide a safe take-off path under both OEI and normal conditions. In light wind conditions, a minor heading change of 10° would not cause a handling problem to the pilot. In stronger winds the take-off distance required would be shorter and so an early turn at 500 ft could be made.

The location and proximity of the WTGs shown in Figure 2 will have no major operational impact on day VFR operations to the Kish Tower helipad.