Morecambe Offshore Windfarm: Generation Assets

Examination Documents

Volume 9

The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix A: The Applicant's Comments on Spirit Energy and Harbour Energy Aviation Access Study Report

Document Reference: 9.35.1

Rev 01

MORECAMBE

Document History

Doc No	MOR001-FLO-CON-ENV-NOT-0014	**Rev**	01
Alt Doc No	n/a		
Document Status	Approved for Use	**Doc Date**	12 December 2024
PINS Doc Ref	9.35.1	**APFP Ref**	n/a

Rev	Date	Doc Status	Originator	Reviewer	Approver	Modifications
01	12 December 2024	Approved for Use	Anatec	Morecambe Offshore Windfarm Ltd	Morecambe Offshore Windfarm Ltd	n/a

Comments on Spirit Energy and Harbour Energy Aviation Access Study Report

1 Introduction

The Applicant has undertaken a review of the AviateQ International Limited "Morecambe Offshore Windfarm" report provided by Spirit Energy. The Applicant's comments on the report are provided in Table 2.1.

2 The Applicant's Comments

Table 2.1 The Applicant's Comments

Comment ID	AviateQ Text	Applicant's Comment
1	**1. Terms of Reference** Spirit Energy operates manned and normally unattended installations in the Morecambe Bay area of the East Irish Sea. During the past decade, and in alignment with the United Kingdom Government objectives to develop renewable energies, the area has witnessed an extensive and ongoing development of windfarms. Morecambe Offshore Windfarm Limited, a joint venture between Cobra Instalaciones y Servicios, S.A. (Cobra) and Flotation Energy Ltd., is planning the development of the Morecambe Offshore Windfarm. The earliest anticipated commencement of any construction is 2026. Wind turbines will be constructed in closer proximity to the Sprit Energy operated Morecambe south central drilling, production and accommodation complex, CPC1, and the Harbour Energy owned Calder production platform, a normally unattended installation (NUI). Currently, the airspace surrounding these facilities is unobstructed allowing	The Applicant notes this response.

Comment ID	AviateQ Text	Applicant's Comment
	unrestricted access under Visual Flight Rules (VFR) or Instrument Flight Rules (IFR), day and night. Recognising the need for co-existence and the potential of turbines to become obstacles in the current obstacle free environment, Spirit Energy (Spirit) contracted the independent services of AviateQ International Limited (AviateQ) to: ▪ Review the windfarm development plans and the proposed positioning of wind turbines in the vicinity of the CPC1 and the Calder; ▪ Taking into consideration Spirit's responsibilities associated with the operation of these facilities and the continuing need beyond 2026 for access by air in Leonardo AW139 and AW169 helicopters, determine the unobstructed airspace required to ensure continued safe Commercial Air Transport (CAT) helicopter access to the CPC1 and Calder; and ▪ Verify the airspace requirements.	

Comment ID	AviateQ Text	Applicant's Comment
2	**2. Scope and Criteria** The scope and criteria are designed to take into consideration the relevant current and potential future regulatory and operational requirements that ensure the safe operation of helicopters to the Sprit Energy operated Morecambe South Central drilling, production and accommodation complex, CPCl, and the Harbour Energy owned Calder production platform, a normally unattended installation (NUI). This encompasses flights to the CPCl and Calder production platform during Visual Meteorological Conditions (VMC) and Instrument Meteorological Conditions (IMC) day and night. The following captures the key elements in broad outline: ▪ Commercial Air Transport Regulations ▪ Guidance from the UK Civil Aviation Authority ▪ UK Aircraft Operator Approved Operations Manuals (HOFO) ▪ UK Aircraft Operator Approved Standard Operating Procedures ▪ AW169 and AW139 Rotorcraft Flight Manual ▪ Minimum En-Route Requirements ▪ Minima for VFR Flights in Class G airspace ▪ UK Aircraft Operator Minimum Cloud Base Requirements/ Proximity of an Array	A long list of requirements is provided, however many of these are actually a subset of the overall Aviation Regulations and Guidance. The Applicant notes the key requirements are: ▪ Specific Approval for Helicopter Offshore Operations (SPA HOFO) ▪ Standard European Rules of the Air (SERA) ▪ CAP (Civil Aviation Publication) 764 ▪ HeliOffshore Approach Path Guidance

Comment ID	AviateQ Text	Applicant's Comment
	▪ UK Aircraft Operator Minimum Horizontal Visibility Requirements/ Proximity of an Array ▪ UK Aircraft Operator Minimum Horizontal Distances from Obstacles when in Instrument Meteorological Conditions ▪ Stabilised Approach Criteria ▪ Airborne Radar Approach (ARA) Criteria ▪ Circling Approaches off an ARA ▪ AW169 Elevated Helideck Continued Take Off Distances One Engine Inoperative (OEI) ▪ AW169 ARA Missed Approach OEI from the Missed Approach Point (MAPt) ▪ Circling Descent into an Embedded Facility ▪ Operating to Facility Adjacent to a Wind Farm Array ▪ Meteorological Data ▪ Effects of turbulence	
3.1	**3. Introduction** Policy and guidance on issues associated with wind turbines and their effect on aviation that need to be taken into considered by aviation stakeholders, wind energy developers and local planning authorities are outlined in UK Civil Aviation Authority (CAP 764). First issued in July 2006, issue 6 dated February 2016 is currently undergoing a review and probable	CAP 764 is Guidance Material but does provide some helpful information which has been applied by the Applicant in the Helicopter Access Report (HAR) (APP-081). However, CAP 764 does not address some key matters, such as obstacle free distances, as those are covered under standard aviation regulations.

Comment ID	AviateQ Text	Applicant's Comment
	update. The scope of CAP 764 explains that the final decision regarding wind farm development rests with the stakeholders, developers and local authorities and since it is not possible or appropriate to prescribe a standard solution, specific cases need to be addressed on a case-by-case basis.	
3.2	This approach has led to many case-by-case studies focusing on how close wind turbine assemblies can be located to offshore installations. Differences of opinion between those representing the oil and gas producers and those representing the wind farm developers have been evident. Additionally, differences in operating procedures and limitations between the major helicopter operators servicing the North Sea offshore industry (North Sea Operators) have also been evident.	The Applicant has taken an evidence-based approach, applying current and proposed future aviation regulations, guidance material and industry best practice. A similar evidence-based approach resulted in Protected Provisions for the Waveney Platform in the Dudgeon and Sheringham Extension Project[1] of 1.26nm for day Visual Meteorological Conditions (VMC) operations. Since the Sumburgh Helicopter Accident in 2013, helicopter operators have contributed to the HeliOffshore working groups producing guidance on best practices, which is then followed by all the operators. For example, the Flightpath Guidance document includes the 0.5nm stabilisation point for a day VMC approach. The differences between operators tend to be minor in nature and not safety related.

[1] The Sheringham Shoal and Dudgeon Extensions Offshore Wind Farm Order 2024

Comment ID	AviateQ Text	Applicant's Comment
		Due to the growth in offshore wind farms, helicopter operators are increasingly flying to both oil and gas platforms adjacent to wind farms and for wind farm operators where they fly to platforms located within the wind farms. The difference in procedures between the two types of flight are minimal as both are conducted under the same Commercial Air Transport Regulations, in particular SPA HOFO.
3.3	This report, initiated in November 2022, was not compiled in isolation. The major UK North Sea Helicopter Operators providing offshore aviation support services to the oil and gas industry set up a working group (NSHO WG) towards the end of 2022 to discuss the issue of operating in the vicinity of wind farms. The purpose of the working group is to finally agree on and where necessary revise Standard Operating Procedures (SOPs) for adoption by all UK offshore helicopter operators when supporting the oil and gas industry. Aware of progress being made by the NSHO WG, the opportunity was taken to meet with the respective NSHO WG representatives, individually, to present the approach being taken by AviateQ. These meetings confirmed that AviateQ was in alignment with current industry thinking and in certain areas was ahead in determining the dimensions of the airspace as reflected in the diagrams contained in this report.	The Minutes from the NSHO WG appear to try and differentiate operations into 3 groups: ▪ Operations inside wind farms ▪ Operations to oil and gas platforms near wind farms ▪ Operations to oil and gas platforms which have placed their own wind turbines nearby (North Sea electrification) As the hazards will be common in each case, then the same criteria will apply. To try and differentiate between the operations and cherry pick is not valid. The Civil Aviation Authority (CAA) is due to consult on any proposed changes to the regulations (as listed in 2 above). As part of this process, the CAA has been given contact details at Renewables UK (RUK), who represent interested parties.

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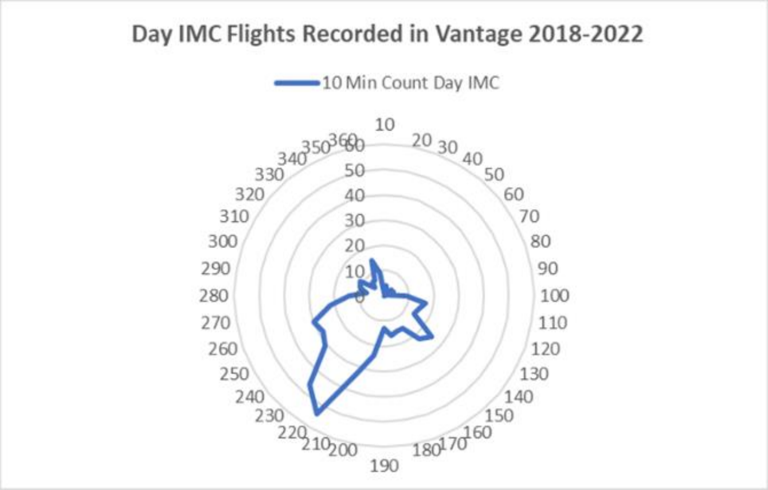
3.4	This report does not address the Point-in-Space (PinS) concept of operating helicopters based on Global Navigation Satellite System (GNSS) enhanced by Satellite Based Augmentation Systems (SBAS) permitting flight in Instrument Meteoritical Conditions (IMC) to and from specific way points. While in development in some onshore locations in Europe it is anticipated that PinS offshore the UK will take significant investment and detailed research before being considered; external factors such as the potential effect of turbine rotor discs on satellite signals being amongst them. Helicopters fitted with advanced on-board avionics which are compliant with the technical system requirements needed to fly these new procedures with very high accuracy (RNP1/RNP0.3/RNP APCH) within 1.0/0.3 nautical miles (nm) on either side of the nominal flight path need to be able to achieve this accuracy at least 95% of the time. The current airspace requirement for an Airborne Radar Approach (ARA) is that there are no obstacles within 1nm either side of the approach path.	Performance Based Navigation (PBN) approaches, such as PinS approaches, have not been considered by the Applicant in the initial helicopter access report. However, it is a potential mitigation for a number of reasons: ▪ The AW169 and AW139 helicopters are already certified for PBN approaches. ▪ Pilots are training for PBN operations post 2020. ▪ The space required for an approach can be significantly less than required for an Airborne Radar Approach (ARA). ▪ The CAA has supported modifying the basic ARA profile since May 2010 (Ref. i). A Point in Space approach is unlikely to provide significant benefits, but a Localiser Performance with Vertical Guidance (LPV) would enable an autopilot coupled approach to be flown to lower minima. The CAA has conducted research into individual helicopter manufacturers' systems, which is a follow-on from their SBAS Offshore Approach Procedure.
3.5	At the time of the issue of this report, the NSHO WG was continuing with its joint review of SOPs covering flights over, into and in the proximity of wind farm arrays / turbines. This	It is understood that any changes to the SPA HOFO will be at the level of Acceptable Means of Compliance and Guidance Material, i.e. "soft law". Acceptable Means of Compliance

Comment ID	AviateQ Text	Applicant's Comment
	includes trials in flight simulators and the analysis of Helicopter Flight Data Monitoring (HFDM) data which is estimated to take between 6-12 months to complete. The NSHO WG has yet to agree and finalise the minimum airspace requirements which will be passed to the UK CAA for possible inclusion in CAP 764. Changes to future SOPs may well have an impact on the airspace requirements identified in this report especially when considering larger helicopter types such as the Sikorsky S92A which will call for longer distances when taking off from an elevated offshore helideck in the event of an engine failure just after the take-off decision point. Whilst best endeavours have been made when calculating the minimum required airspace distances in this report, these distances may well prove to be different to those finally adopted by the UK North Sea Helicopter Operators and by the UK CAA for inclusion as guidance in CAP 764. Revision 2 of this report was issued due to changes in the minimum distances required for both the VFR and IFR operations on the AW169. During discussions with the current helicopter operator to verify the accuracy of the information within the report it came to light that AviateQ had failed to include the level acceleration from Vtoss to Vy in the departure	(AMC) adopted by the CAA are means by which the requirements in the UK Regulation (EU) 2018/1139 (UK Basic Regulation) and it's Implementing Rules can be met. Since requirements can be met by other means, regulated persons and organisations may apply for permission to use alternative means to comply with the law by the use of Alternative Means of Compliance (AltMoC). For the CAA to accept AltMoC the applicant will need to demonstrate that the alternative approach nonetheless maintains compliance with the law. An operator will be able to propose an AltMoC, as shown in CAP 1721. Applying an AltMoC does not lead to a reduction in safety. Aviation regulations adopt a prescriptive approach, which frequently lag advances in technology or operational procedures. However, to prevent innovation being stifled, variations from the regulations are permitted where an equivalent or better level of safety can be demonstrated. An AltMoC is an example of this approach to permit innovation whilst maintaining an acceptable level of safety. An example is the AW169 helicopter used by IPs in the Morecambe Bay gas fields. The AW169's Type Certificate Data Sheet shows that six Special Conditions were applied during certification and 11 Equivalent Safety Findings were applied. A Special Condition is

Comment ID	AviateQ Text	Applicant's Comment
	profile. This portion of the take-off profile is not illustrated on the profile diagram within the Rotorcraft Flight Manual nor is it mentioned in the description of the continued OEI take-off profile, it is only addressed in the Performance section of the RFM. This has now been corrected in Revision 2 of the report. Changes to future SOPs may well have an impact on the airspace requirements identified in this report especially when considering larger helicopter types such as the Sikorsky S92A which will call for longer distances when taking off from an elevated offshore helideck in the event of an engine failure just after the take-off decision point.	applied when the certifying authority finds that the airworthiness regulations for an aircraft or aircraft engine do not contain adequate or appropriate safety standards, because of a novel or unusual design feature. An Equivalent Safety Finding is another way to meet the certification requirements, usually through an Alternative Means of Compliance. In summary, applying an AltMoc for approaches in Instrument Meteorological Conditions (IMC) to CPC-1 post any CAA rule change is consistent with aviation practice, aimed at maintaining safety levels whilst providing flexibility. The distance required for an approach will depend on the airspeed flown and is independent of the aircraft type. The distance required for a One Engine Inoperative (OEI) take-off depends on the helicopter's rate of climb, not type. The Applicant has calculated required approach and take-off distances in Section 4 of The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix C: Helicopter Supporting Information Technical Note (Document Reference 9.35.3). The S92 has not been used in the Morecambe Bay Gas Fields.
4.1	**4 Assumptions** **4.1 Meteorological Data**	The same Meteorological data was supplied to the Applicant.

Comment ID	AviateQ Text	Applicant's Comment
	a) The Met Ocean weather data used, obtained by Harbour Energy from Viasat, was forwarded to AviateQ via Spirit Energy. The data covered the period from 2017 to 2022 and averaged out over the 5-year period indicated a prevailing wind from 210° at 15 knots (kts). This value has been used throughout this report.	The HAR carried out by the Applicant did not use a fixed wind direction but considered both VMC and IMC prevailing wind directions and therefore covering a wider range of wind directions more relevant to real operations. The Mean windspeed during the period of the met data supplied was 17.0kts and the Median was 15.8kts. Further information is provided in The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix C: Helicopter Supporting Information Technical Note (Document Reference 9.35.3). 
4.2.a	**4.2 Helicopter Types and Performance** a) The primary helicopter operating offshore in the East Irish Sea supporting Sprit Energy is the Leonardo AW169 with the	It has been assumed that the prime helicopter is the AW169 with the AW139 as a backup.

Comment ID	AviateQ Text	Applicant's Comment
	AW139 as a backup. Given that the performance of the AW139 is superior to the AW169, all performance calculations have been based on the AW169 Rotorcraft Flight Manual to ensure that the airspace requirements would be suitable for both aircraft types.	
4.2.b	b) All performance calculations are based on the AW169 Performance Class 2e (PC2e) with zero exposure.	The relevant AW169 take-off performance graphs have been utilised, so compliant with PC2e.
4.2.c	c) For the continued take off following an engine failure at the Take off Decision Point (TDP) when departing an elevated helideck, the First Sector climb performance is based on the AW169 2.5-minute One Engine Inoperative (OEI) rating until reaching a height of 200ft. Thereafter, the Maximum Continuous OEI Rating has been applied. Meteorological conditions are based on ISA (15°C) and a 15kts headwind.	The applicable AW169 RFM (Rotorcraft Flight Manual) profiles and engine ratings have been applied. The meteorological data provided by Spirit Energy showed the Mean temperature for IMC was 10.3^{o}C, with a Median temperature of 9.8^{o}C. For this assessment a conservative approach has been taken and a temperature of 15^{o}C used. The Mean windspeed was 17.0kts and the Median was 15.8kts. Factored windspeeds of 10kts, 15kts and 20kts were used. Windspeed is factored by 50% to take a precautionary approach. The AviateQ report used Sea Level (1013 hPa) air pressure, which is the same value applied by the Applicant.
4.3.a	**4.3 Day VFR Operations** a) Unobstructed VFR corridors leading towards oil and gas facilities in the operating area will be oriented 210° into the prevailing wind.	Other schemes have agreed an obstacle free radius of 1.26nm, or less, for example the Protected Provisions for the Waveney Platform in the Dudgeon and Sheringham Shoals Extension

Comment ID	AviateQ Text	Applicant's Comment
		Project Development Consent Order (DCO)[2]. These distances have been agreed with helicopter operators and take account of the HeliOffshore Approach Path Guidance, including stabilised approach criteria. Further detail on the calculation of this distance is provided in Section 4 of The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix C: Helicopter Supporting Information Technical Note (Document Reference 9.35.3). Orientation on a single axis is not sufficient. The current obstacle free distances proposed by the Applicant are sufficient for day VMC operations. However, it is agreed that providing an additional take-off distance orientated to the south west will enhance access in IMC and at night.
4.3.b	b) The transit height for helicopters overflying windfarm arrays is a minimum of 500ft above the rotor tip of the highest turbine in the overflight area.	There should be no need to overfly the wind farm as the flightpath from Blackpool Airport to the South Morecambe Platform, and then shuttle flights to Normally Unmanned Installations (NUIs), will remain laterally displaced from the wind farm.
4.3.c	c) When remaining clear of cloud and in sight of the surface in accordance with VFR requirements, the minimum vertical distance between the helicopter and the cloud base has been set at 100ft.	This is agreed.

[2] The Sheringham Shoal and Dudgeon Extensions Offshore Wind Farm Order 2024

Comment ID	AviateQ Text	Applicant's Comment
4.3.d	d) The Final Approach Sector (FAS) leading up to the Stabilised Approach Point (SAP) has been set at 1nm for standardisation although some pilots may elect, due to wind conditions, to intercept the FAS at a point closer than 1nm.	The HeliOffshore Stabilised Approach Point is 0.5nm, Bond Helicopters use 0.75nm. The distance of 1.26nm was agreed in the Dudgeon Extension DCO following consultation with Bond Helicopters. A Stabilised Approach Point of 1nm for day VMC is excessive and not supported by industry guidance and draft CAP 764 paragraph 5.24.c[3]
4.3.e	e) The maximum groundspeed during the final approach is 80kts. With a headwind of 15kts the time taken to cover the 1nm leading up to the SAP is 55 seconds.	A stabilised approach would commence at 80kts airspeed and the ground speed would depend on the wind speed.
4.4.a	**4.4 Day and Night IFR Operations** a) The current requirement for aircraft to remain clear of all obstructions by 1nm either side of the Final Approach Track when conduction an Airborne Radar Approach will apply equally to significant structures such as wind turbines as it does for transiting vessels, temporary jack-ups or fixed platforms.	The same standard requirement is applied in the HAR.
4.4.b	b) Unobstructed IFR corridors leading towards oil and gas facilities in the operating area will be oriented 210˚ into the prevailing wind.	It is agreed that providing additional access to the south west will enhance IMC and night access. The Applicant has proposed a take-off corridor in The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix B: Helicopter

[3] https://consultations.caa.co.uk/policy-development/proposed-revision-to-cap-764-caa-policy-and-guidel/supporting_documents/Draft%20CAP764%20Ed7%20Red%20Underline.pdf

Comment ID	AviateQ Text	Applicant's Comment
		Access IMC Corridor (Document Reference 9.35.2) which will greatly enhance IMC and night access.
4.5		
4.5.i	**4.5 VFR and IFR Scenarios Evaluated** The following scenarios have been evaluated to determine the required unobstructed airspace requirements : VFR – Dimensions of a VFR access corridor permitting a 180° Rate One turn withing the confines of the corridor. (Section 7.2)	An obstacle free radius of 1.26nm has previously been agreed with an operator, applying a stabilisation point at 0.75nm.
4.5.ii	VFR - Accessing a facility in the centre of a HPZf via a VFR corridor and positioning for an approach with the wind from any direction. (Section 8.2)	The term HPZf is not a term used in UK aviation regulations.
4.5.iii	VFR - Engine failure after take-off from a facility with OEI climb to 500ft followed by a Rate One turn. (Section 8.3)	The HAR applies a climb to 500ft above sea level before turning; this height above sea level has previously been agreed with the helicopter operators for other projects. The AviateQ Report applies a climb to 500ft above helideck height which results in a different OEI take-off distance depending on the helideck height. In the case of the South Morecambe Platform this will require a climb to 684 ft for the CPC-1 helideck (500ft + height of the helideck, 184ft) whilst a take-off from the DP-1 helideck, at the other end of the South Morecambe platform, will only require a climb to 594ft (500ft

Comment ID	AviateQ Text	Applicant's Comment
		+ height of the helideck, 94ft). Furthermore, as the current day VMC limits permit a cloud base as low as 600ft above sea level, a climb from CPC-1 to 684ft would result in a climb into IMC. Even applying the proposed CAA rule change of a minimum cloud base of 700ft would result in the helicopter climbing within 100ft of the cloud base and so being IMC – see the AviateQ Report 4.3 c) that states: "*when remaining clear of cloud and in sight of the surface in accordance with VFR requirements, the minimum vertical distance between the helicopter and the cloud base has been set to 100ft*". For consistency with other projects, and in accordance with standard practice, all heights used in the report should be above sea level and not above helideck height.
4.5.iv	VFR – Accessing a facility located adjacent to a wind farm array with the turbines positioned on one side. (Section 8.4)	
4.5.v	VFR - Overflying a wind farm array to access a facility in the centre of a HPZf without a VFR corridor, conducting a circling descent and positioning for an approach with the wind from any direction. Additionally, following an engine failure after take-off from the facility to climb to 500ft followed by a circling climb to 1,500ft to exit the HPZf and transit on only one engine over the windfarm array. (Section 8.5)	As no helidecks are located inside the wind farm, it is not understood why this profile is required. A spiral descent does not meet the standard stabilised approach criteria and so should not be used.

Comment ID	AviateQ Text	Applicant's Comment
4.5.vi	IFR - ARA approach to enter a HPZf via a 2nm wide corridor oriented into the prevailing wind. (Section 9.2)	1nm either side of track free from obstruction is required for an IMC approach when below the Minimum Safe Altitude (MSA).
4.5.vii	IFR – Engine failure at the ARA Missed Approach Point with OEI climb in IMC to 1,000ft followed by a Rate One climbing turn to reach MSA before exiting via the ARA approach corridor. (Section 9.5)	This is the standard ARA profile shown in the HAR.
4.5.viii	IFR - Engine failure after take-off from a facility with OEI climb in IMC to 1,000ft followed by a Rate One climbing turn to reach MSA before exiting via the ARA approach corridor. (Section 9.6)	An OEI climb to 1,000 ft above sea level followed by a Rate One turn has been applied in the HAR and supporting technical notes. The AviateQ Report shows a climb to 1,000ft above helideck height, whilst previously it has been agreed with the helicopter operators that a climb to 1,000ft above sea level is required before turning. A climb to 1,000ft above helideck height results in a different OEI take-off distance for each helideck in the area, as they all have different helideck heights. It is not understood why a corridor is required as flight at MSA permits unobstructed access in any direction.
4.5.ix	IFR - Positioning overhead a facility inside a HPZf and executing a letdown procedure within the confines of the unobstructed airspace to setup an ARA, initially joining the Final Approach Track at a defined distance from the facility with the wind from any direction. Additionally, an engine failure after take-off	Overflight of the wind farm is not required, and so this section is not applicable.

Comment ID	AviateQ Text	Applicant's Comment
	from the facility with OEI climb in IMC to MSA and transit on only one engine over the windfarm array. (Section 9.4)	
5.1	AIRCRAFT OPERATOR STANDARD OPERATING PROCEDURES – LIMITATIONS 5.1 Wind Turbines Near Oil and Gas Facilities The UK North Sea Operators working group participants reached agreement during February 2023, concluding that: 1. Whenever wind turbines are located within 3nm of an offshore oil and gas facility (including visiting mobile units fitted with helidecks), all flights to the facilities shall be restricted to Day Visual Flight Rules (VFR) only.	This is being considered by the CAA. The CAA has not yet consulted on any regulatory changes. Some operators are still conducting approaches in IMC to helidecks within 3nm of wind turbines. Please refer to Section 4 of The Applicant's Response to Spirit Energy Deadline 1 Submissions (Document Reference 9.35)
5.1	2. The cloud base for Day VFR flights to such facilities shall not be lower than 700ft Above Mean Sea Level (AMSL).	Although not yet included in any CAA regulations, this assumption has been applied to the HAR.
5.1	3. The horizontal visibility in the operating environment shall not be less than 5km.	Although not yet included in any CAA regulations, this assumption has been applied to the HAR.
5.1	4. All air corridors must be direct, straight line of sight without any bends. (Possibly being reassessed).	This is contradicted by the Hornsea Four DCO where access to the Johnston Wellheads includes turns. The Johnston Wellheads access corridors were agreed with Harbour Energy. As these flights will be under day VMC a dog leg in a transit lane is not an issue.
5.1	5. The Stabilised Approach Point (SAP) shall be 0.5nm from the destination helideck.	The distance of 0.5nm is agreed; this is consistent with current industry guidance and best practice. In their paragraph 4.3 (d)

Comment ID	AviateQ Text	Applicant's Comment
		AviateQ claim a distance of 1nm is required, which is inconsistent with their point 5.5.
5.2	5.2 Flying Within and Adjacent to Windfarm Arrays Aircraft service providers operating into windfarm array areas can be described as those supporting: i. Windfarm construction and maintenance; and ii. Non windfarm related activities such as oil and gas. Pilots flying aircraft in support of windfarm construction and maintenance could be considered as experienced in flying amongst turbine towers with the associated movement of the turbine blades as they are exposed to such as a matter of routine. They will also be familiar with overall array areas and the routes used. Some of these operators use a distance of 0.3nm as the "stabilised" point on the approach to the helideck. Pilots flying aircraft primarily to oil and gas facilities do not normally fly into windfarm arrays and those who do operate into these areas tend to do so on an infrequent basis. Operating procedures when flying into oil and gas facilities outside, inside and adjacent to a wind farm array need to be standardised for these pilots with, for example, the Stabilised	All commercial air transport helicopter offshore operations are covered under SPA HOFO: ▪ support of offshore oil, gas and mineral exploration, production, storage and transport; ▪ support of offshore wind turbines and other renewable-energy sources; or ▪ support of ships including sea pilot transfer. In SPA HOFO 'Offshore location' means a location or destination on a fixed or floating offshore structure or vessel, and includes helidecks, helicopter hoist operations areas and operating sites. 'Offshore location' includes, but is not limited to: ▪ helidecks; ▪ shipboard heliports; and ▪ winching areas on vessels or renewable-energy installations (Ref. ii). It is common practice for pilots to conduct flights to both oil and gas helidecks, as well as renewable helidecks. For

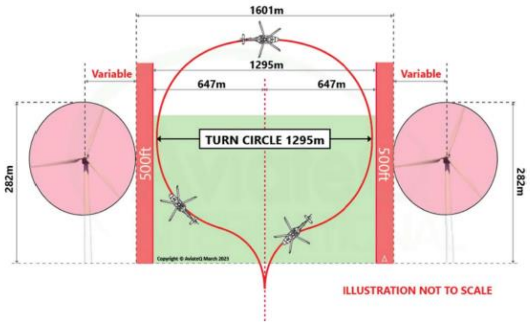
Comment ID	AviateQ Text	Applicant's Comment
	Approach Point being set at a minimum distance of 0.5nm from the facility.	example, for several operators in Norwich. Flights to helidecks close to current wind farms in Morecambe Bay (e.g. flights to Non-Production Installations (NPIs) whilst working at Rhyl Field inside Walney extension) have been conducted for several years, so is not a new concept. It is agreed that at least one operator uses 0.3nm as their stabilisation point and that 0.5nm is the distance applied in industry guidance. A more conservative distance of 0.75nm has been assumed in the HAR. This results in an obstacle free radius of 1.26nm as stated in the Protected Provisions for the Waveney Platform in the Dudgeon and Sheringham Shoals Extension Project DCO. Further details of this calculation are provided in the response to Comment ID 8.2 and Section 4 of The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix C: Helicopter Supporting Information Technical Note (Document Reference 9.35.3).
6.1	**6. AIRSPACE REQUIREMENTS** **6.1 Helicopter Protected Zones (HPZs)** Access to and from non-wind farm related facilities need to be conducted in unobstructed airspace thereby ensuring the safety of offshore Commercial Air Transport (CAT) by helicopter, thus protecting the passengers and crew and potentially third parties in the vicinity. The unobstructed	The HAR applies the regulations in the form of SPA HOFO and the SERA. A HPZ has no regulatory basis. SPA HOFO and SERA already define the obstacle avoidance criteria.

Comment ID	AviateQ Text	Applicant's Comment
	airspace requirement can be broken down into different "zones" namely the arrival and departure zone and the zone around the facility whether this be a fixed platform or a mobile unit servicing a subsea well. These zones are referred to in this report as Helicopter Protected Zone - Corridor (HPZc) and Helicopter Protected Zone - Facility (HPZf). Helicopter Protected Zones (HPZs) comprise of a horizontal and vertical airspace component with the dimensions of each of the components depending on the type of flying activity. For operations at night in poor weather conditions the dimensions of the HPZ are understandably greater than that required for daytime only operations.	
6.2	**6.2 Wind Turbines** The size of offshore horizontal-axis wind turbines (HAWT) varies with the radius of the rotor blade being one of the driving factors when determining the height of the supporting tower. Turbines installed offshore are usually three bladed. The rotor blades are attached to the main rotor shaft (hub) located at the top of the tower. The hub is installed on a yaw system which is used to orientate the blades into wind.	The Applicant notes this comments.
6.3	**6.3 Helicopter Protected Zones - Corridor (HPZc)** To access a facility inside a wind farm array a Helicopter Protected Zone Corridor (HPZc), free from all obstructions, must be provided. The dimensions of the HPZc depends on	As no gas platforms are located inside the wind farm this section is not relevant. It should also be noted that the term "HPZc" has no regulatory basis. SPA HOFO and SERA already define the obstacle avoidance criteria.

Comment ID	AviateQ Text	Applicant's Comment
	whether the flying activity will be conducted day only in Visual Meteorological Conditions (VMC) or day and night in Instrument Meteorological Conditions (IMC).	
6.4	**6.4 Positioning of Turbine Towers** The orientation of the turbine rotor disc (rotating blades) is normally influenced by changes in wind direction. To guarantee that Helicopter Protected Zones (HPZs) remain free of any obstructions, the positioning of the turbine tower must be such that the rotor tips of the rotor blades must not penetrate the HPZ irrespective of the orientation of the rotor disc.	The HAR and draft DCO apply the distance from the turbine blade tip at the worst-case orientation. Therefore, this issue has already been addressed.
7.1	**7.1 Day VFR Requirements** The helicopter operator currently providing services to Spirit Energy requires a flight visibility of 5km and has accepted a minimum cloud base of 700ft.	This assumption has been applied in the HAR, although it is not regulation.
7.2	**7.2 Helicopters Turning Around in a HPZc** In the event of an abnormal or emergency situation arising whilst enroute, the pilot may need to execute a 180^0 turn inside the corridor. The space required is determined by calculating the radius of the turn which depends on both the rate of turn (bank angle i.e. how quickly the heading changes) and the airspeed. When airspeed increases the turn radius increases. When the rate of turn increases, the turn radius	As the HAR and dDCO applies distances from the turbine tip at worst-case orientation, the discussion about the HPZc is not required. It is standard practice to reduce airspeed when close to obstacles.

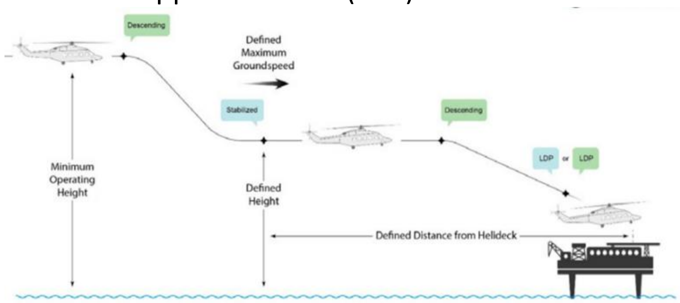
Comment ID	AviateQ Text	Applicant's Comment
	decreases. Typically, the AW169 cruises at 125kts, just over 2nm per minute. Irrespective of the type of event, the airspeed would need to be reduced to execute a safe turn in the corridor	
7.3	**7.3 Calculating the Radius of Turn** An accepted formula, $r = V^2/g \tan Ø$ where: r = radius of turn (m) $g = 9.81\ m/s^2$ V = true airspeed (kts), Ø =Angle of bank (°) Based on an airspeed of 80kts and a 15^0 angle of bank (Rate One Turn -3° per second based on autopilot function) the radius of turn would be 647m (0.35nm). As can be determined from ***Figure 2*** below, the turning circle requires a minimum distance of 1,295m. Allowing for an obstacle clearance requirement of 500ft (153m) either side of the corridor equates to an overall unobstructed corridor width of 1,600m.	The formula is agreed. This section seems to be considering flight within a wind farm, which is not required. If flight inside the wind farm is needed, this width of corridor is not required, as the helicopter would offset to one side before making a turn, as is done when flying in a valley, up the Thames Heli-lanes etc. The Hornsea Four Johnston Wellheads Protected Provisions (PPs) can be used as an example[4].

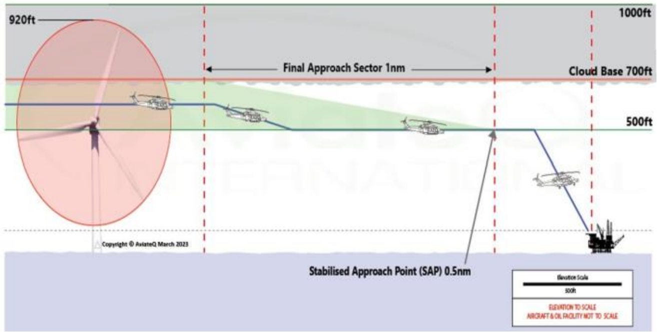
[4] The Hornsea Four Offshore Wind Farm Order 2023

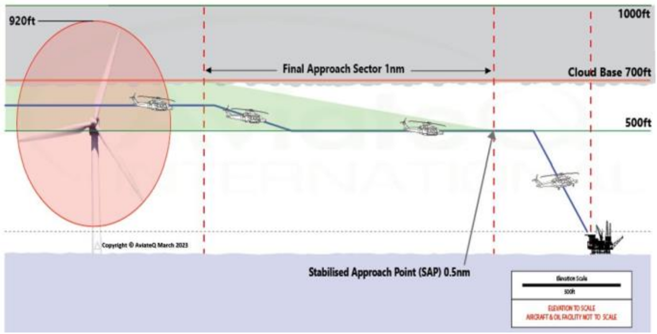
Comment ID	AviateQ Text	Applicant's Comment
	 Figure 2 HPZc Turning Circle (Arc) @ 80 kts and a 150 (Rate One Turn) Bank Angle = 1,295m + Obstacle Clearance (2 x 153m) 1,600m. (Arc = 2xr)	
7.4	**7.4 Helicopter Protected Zone - Facility (HPZf)** Having established the VFR corridor width requirements, the airspace requirement around a facility within a wind farm array when operating VFR under a 700ft cloud base also needs to be determined.	The term HPZf is not used in aviation regulations or guidance material.
8.1	**8. VFR OPERATING CONSIDERATIONS in an HPZf** **8.1 Stabilised Approaches** A helicopter approaching a landing point must make a stabilised approach. The purpose of a stabilised approach is to ensure the helicopter is in the correct configuration and on the correct flight path for landing, with gear down, and groundspeed at the correct value for the conditions. The aim is	What the AviateQ Report requires is a pre-stabilisation point at 1.5nm before the actual stabilisation point at 0.5nm. This is not consistent with industry guidance or current practice. In fact, under current industry guidance a turn can be made up to the stabilisation point at 0.5nm.

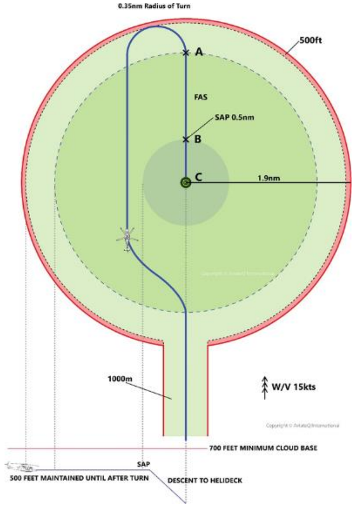
Comment ID	AviateQ Text	Applicant's Comment
	to minimise pilot workload in the final approach segment down to the approach termination point resulting in a safe landing. A stabilised approach is conducted for all approaches as it provides the optimum safety configuration and follows a standard procedure for which both crew members are trained. An approach is stabilised when the following criteria are met: ▪ The helicopter is in the correct landing configuration and the indicated airspeed is stable at the briefed approach speed +/- 10 KIAS. ▪ The helicopter is on the correct briefed flight path. ▪ Only small changes in heading and power are required to maintain the flight path. In VFR conditions the helicopter will be established on finals 1.5nm from the landing site to ensure that it is correctly configured at the 0.5 Stabilised Approach Point. Providing crews with repeatable operating practices designed to manage flightpath control effectively and maintain awareness of the state of the helicopter offers strong mitigation against any potential loss of control.	The 0.5nm stabilisation point is in industry guidance, however a more conservative distance of 0.75nm was used by the Applicant in the HAR. The Applicant's helicopter specialist was the co-author of the HeliOffshore Approach Path Guidance and has confirmed the following: Firstly, this section of the HeliOffshore Guidance refers to approaches in degraded visual conditions (poor visibility or at night) and not day VMC. Secondly, the diagram is a 2D illustration and does not prevent turning before the 0.5nm stabilisation point. For example the ARA profile includes a turn towards the helideck at 0.75nm and then a further turn to orientate into wind; this is also not shown in the ARA vertical profile. The use of a stabilisation point at 0.5nm is supported by the CAA's Draft CAP 764[5] that has been issued for consultation. In section 5.23.c. it states: *"When a helideck is within a windfarm there may be operational difficulties when manoeuvring for a stabilised approach. Obstacle clearance around a helideck within a windfarm should allow aircraft to achieve Final Approach*

[5] CAP 764

Comment ID	AviateQ Text	Applicant's Comment
	Below is an extract from the HeliOffshore Flight Path Management, V3, showing recommended Standardised Approach Criteria. As can be seen, the distances are left to the discretion of the operator. However, Annex B "Recommended Guidance Points on Stabilised Approaches" does recommend a Stabilised Approach Point (SAP) of 0.5 m.  The North Sea Operators working group, having considered a Stabilised Approach Point (SAP) distance of 0.3nm from the helideck has recently agreed that 0.5nm is required. Most operators are using 500ft as the defined height. Differences in the defined height at the SAP do not impact on the SAP distance. Below is a diagram (elevation to scale) depicting a 700ft cloud base, a 920ft turbine and a stabilised approach profile consisting of a Final Approach Sector (FAS) of 1 nm and a SAP	*Track (FAT) and 0.5 NM stabilised approach Visual Meteorological Conditions (VMC) gate. For operations in a Degraded Visual Environment (DVE) a second stabilised approach gate is introduced at 1 NM.* ***Note: this is 1nm from the landing point and not an additional 1nm beyond the stabilisation point****. DVE is determined to exist when visibility is below 4000m. The minimum visibility of 5000m* gives a *margin above DVE ensuring there is no requirement for the extended FAT."* So, the additional 1nm applied in the AviateQ Report is not consistent with current operational guidance, or the future CAA CAP 764. 0.75nm has been used in the HAR. With a cloud base of >=700ft then a 500ft level sector before the stabilisation point is always available. The turbine height is irrelevant as the helicopter will remain outside the wind farm.

Comment ID	AviateQ Text	Applicant's Comment
	at 0.5nm from the facility. Note the upper portion of the turbine blades are obscured by cloud 	
8	The North Sea Operators working group, having considered a Stabilised Approach Point (SAP) distance of 0.3nm from the helideck has recently agreed that 0.5nm is required. Most operators are using 500ft as the defined height. Differences in the defined height at the SAP do not impact on the SAP distance. Below is a diagram (elevation to scale) depicting a 700ft cloud base, a 920ft turbine and a stabilised approach profile consisting of a Final Approach Sector (FAS) of 1 nm and a SAP at 0.5nm from the facility. Note the upper portion of the turbine blades are obscured by cloud.	0.75nm has been used in the HAR, this is a conservative distance as the HeliOffshore Approach Path Guidance requires a minimum distance of 0.5nm. With a cloud base of >=700ft then a 500ft level sector before the stabilisation point is always available. The turbine height is irrelevant as the helicopter will remain outside the wind farm.

Comment ID	AviateQ Text	Applicant's Comment
		
8.2	**8.2 Entering a HPZf VFR with a Tailwind and Positioning onto the Approach to Land** Due to variations in wind directions consideration has been given to the possibility of a tailwind when entering the HPZf and the distance taken to position the helicopter onto the final approach track, into wind, including the radius of turn. As can be seen from ***Figure 6*** below, a Final Approach Sector (**A-B**) of 1 nm allows the pilot time to make heading changes ensuring the helicopter is into wind and within the stabilised approach criteria by the 0.5nm SAP (**B**).	The term HPZf is not used in aviation regulations or guidance. With a tailwind, the diagram shows the worst possible flight profile as during the 180° turn onto the final approach, the pilots will not have sight of the wind turbines near their tail. A pilot would actually turn sooner and aim to roll out facing into wind shortly before the stabilisation point. That was agreed with the helicopter operator for access to the Waveney Platform in the Sheringham and Dudgeon Extension DCO. The distance shown of 1.9nm is only required because of the pre-stabilisation point at 1.5nm, which has no basis in regulation, industry guidance or current practice. Evidence

Comment ID	AviateQ Text	Applicant's Comment
	If the helicopter is not in a stabilised configuration on arrival at the SAP the pilot is obliged to execute a missed approach. These manoeuvres are taking place under a minimum cloud base of 700ft. The distance required to execute this manoeuvre including a 500ft (0.08nm) obstacle clearance, results in a total minimum requirement of 1.9nm.  	from current practice and the Sheringham and Dudgeon Extension DCO shows that a distance of 1.26nm is sufficient for a day VMC approach. This is based on: a conservative stabilisation point at 0.75nm; a radius of turn of 0.43nm when flown at 80kt; and a 0.08nm (500ft) obstacle clearance (0.75 + 0.43 + 0.08 = 1.26nm). The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix C: Helicopter Supporting Information Technical Note (Document Reference 9.35.3) provides further details on the required approach distances.
8.3	**8.3 Engine Failure at Take-off Decision Point and OEI Climb to 500ft VMC** Climb to 500ft is stated as taking 1.76nm.	The AviateQ report applies Sea Level ISA (International Standard Atmosphere) conditions of 1013 hPa and 15°C. 15kts of wind is used. The Applicant has also used 1013 hPa and

<table>
<tr><th>Comment ID</th><th>AviateQ Text</th><th>Applicant’s Comment</th></tr>
<tr><td></td><td>The distance required to safely execute a continued take off on one engine following an engine failure on rotation at the Take-off Decision Point (TDP) in the AW169 has been calculated based on the following: (Figure 7A)

1. Drop down height
2. Acceleration from the Take-off Decision Point (TDP) to Take Off Safety Speed (Vtoss) with a positive Rate of Climb (CTO)
3. Path 1 climb from end of CTO to 200ft at Vtoss.
4. Level acceleration from Vtoss to Vy.
5. Path 2 climb from 200ft to 500ft at Vy.
6. Rate one turn at 500ft
7. Pressure altitude of Oft, temperature of 15C, wind velocity of 15kts
8. All heights are Above Take-off Surface (ATS).

Section 1: Acceleration from TDP to Vtoss and positive ROC (CTO)

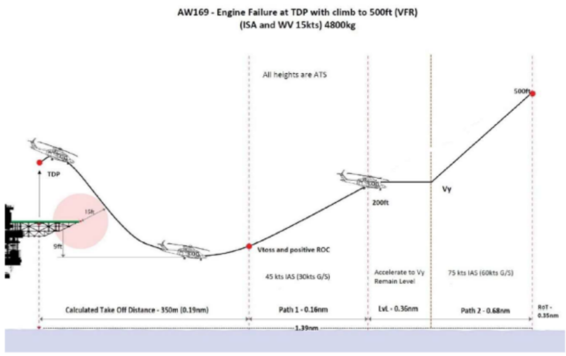
▪ 9ft drop down due head wind factor. (Graph 54T-D15}
▪ Distance required is 350m or 0.19nm. (Section 4- Performance data -OE/ Continued Take-off Distance)

Section 2: Path 1 Climb from end of CTO to 200ft</td><td>15ºC but has used a range of wind conditions typical of those experienced in Morecambe Bay.
The take-off mass applied in the AviateQ Report was 4800kg. However a more realistic take-off mass is 4650 kg or lower.
The Applicant identifies the take-off distances required for a range of aircraft mass and wind conditions in 4.2 and 4.3 in The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix C: Helicopter Supporting Information Technical Note (Document Reference 9.35.3.

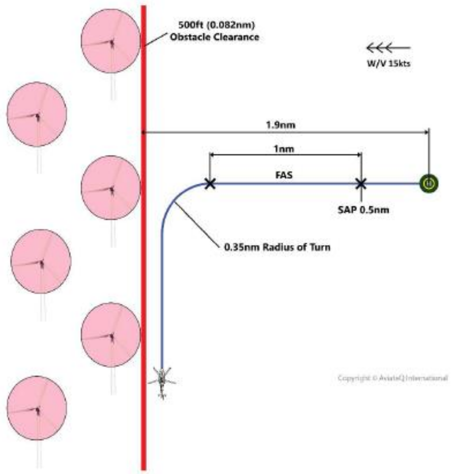
Section 2 shows drag penalties (Graph S4-6) are applied to the AviateQ Flightpath 1 climb performance calculations. Flightpath 1 requires the landing gear to be lowered and so this is not correct.

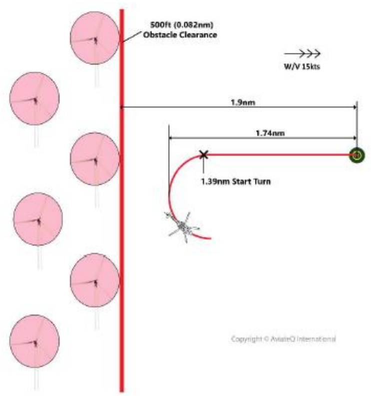
The Applicant’s calculations of the take-off distances required for a range of aircraft mass and wind conditions are shown in The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix C: Helicopter Supporting Information Technical Note (Document Reference 9.35.3).</td></tr>
</table>

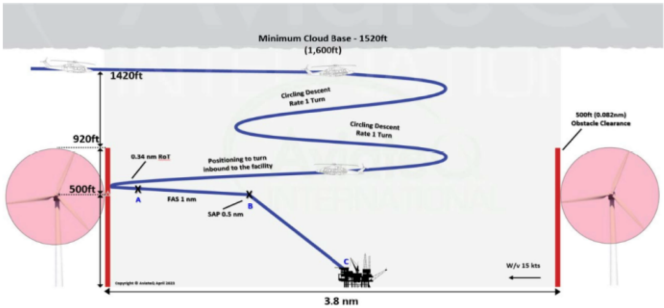
Comment ID	AviateQ Text	Applicant’s Comment
	▪ Speed - Vtoss 45kts IAS (30kts G/S) ▪ Height to climb - 209ft (200ft + 9ft drop down) ▪ Climb at 2 ½ minute power with reduced gradient due to 'Fixed Undercarriage' and 'Life rafts in extended sponsons' ▪ Drag factor - 0.6 *(Graph 54-6)* ▪ Distance travelled= 946.55 ft or **0.16nm** *(Graph 54-7 and 54-22)* **Section 3:** Level Acceleration from Vtoss to Vy at 200' ▪ Accelerating from 45kts to 75kts ▪ Maintaining 2 ½ minute power ▪ Distance required= 660m or **0.36nm** *(Graph 54-32.)* **Section 4:** Path 2 climb from 200ft to 500ft ▪ Speed - Vy 75kts IAS {60kts G/S) ▪ Height to climb - 300ft ▪ Climb gradient at MCP with reduced gradient due to 'Fixed Undercarriage' and 'Life rafts in extended sponsons' ▪ Drag factor - 0.6 *(Graph 54-6}* ▪ Distance travelled = 4109.58or **0.68nm** *(54-9 and 54-43}*	

Comment ID	AviateQ Text	Applicant's Comment
	The total distance required for OEI TDP to 500ft would be the sum of the 4 sections namely 0.19nm + 0.16nm + 0.36nm + 0.68nm = **1.39nm**  **Figure 7A** ***AW169 Profile View of Distance Required Following Engine Failure at TDP with OEI Climb to 500 ft (ISA & W/V 15 kts)*** **Section 4:** Rate One Turn at 500ft (VFR) Total distance required from TDP / OEI to 500ft and taking into consideration the displaced apex of the Rate one Turn as per **Figure 7B: C to E = 1.76 nm.**	
8.4a	**8.4 Oil and Gas Facilities Adjacent to Wind Farm Turbines** **<u>Arrival at Adjacent Facility</u>** The minimum distance required between the windfarm array and the facility is determined by the wind direction. With the	This repeats the error shown in the AviateQ Report Section 8.2, and adds an extra 1nm, shown as the FAS, which is not required by regulation, guidance or current practice. Examples

Comment ID	AviateQ Text	Applicant's Comment
	wind blowing at 90⁰ towards the windfarm array, space is required for the helicopter to position onto the Final Approach Sector (FAS) into wind. **Figure 8** below depicts the helicopter entering the HPZf and flying parallel to the wind turbine boundary in a 15kts crosswind before turning onto the **FAS (A) 1 nm from SAP (B)** to be fully stabilised at the **SAP 500ft / 0.5nm** from helideck (C). The minimum distance required to safely execute this manoeuvre **VFR is 1.9nm**. **Note 1:** For airspace dimensions with regards to IFR operations to adjacent facilities please refer to the airspace requirements shown in Figures 14A and 14B. **Note 2:** Whilst the helicopter could also approach from a different angle, the distances required to establish into wind on the FAS remains the same.	from consented DCOs and current operations dispute the need for an additional 1nm run-in to the stabilisation point.

Comment ID	AviateQ Text	Applicant's Comment
	 Figure 8 *Plan View of Distance Required to establish VFR onto an Approach to a Facility Adjacent to a Wind Farm Array (80 kts / Rate 1 Turn) and in a fully Stabilised Configuration*	
8.4b	**Departure from Adjacent Facility with Engine Failure at TDP** With the wind blowing from the windfarm array at 90° to the array boundary, space is required for the helicopter to depart the adjacent facility, to climb to 500ft and turn away from the obstructions. The wort case scenario is an engine failure just after the Take-Off Decision Point (TDP) when departing the elevated helideck.	This section repeats the calculated distance of 1.76nm. See comments to section 8.3.

Comment ID	AviateQ Text	Applicant’s Comment
	Based on a headwind of 15kts, an AW169 helicopter continuing the take-off directly into wind with One Engine Inoperative (OEI) would, as depicted in **Figure 9** below, fly 0.91nm from **(A)** the facility to **(B), 500ft** above sea level. On reaching 500ft, additional space **(B)** to **(C)** is required to execute the turn away from the obstructions. The minimum distance required to safely execute this manoeuvre in **VFR is 1.76nm.**  Figure 9 *AW169 - Plan View of Distance Required Following Engine Failure at TDP with OEI Climb VFR to 500ft and turn away from Wind Farm Boundary (ISA & Headwind of 15 kts)*	

Comment ID	AviateQ Text	Applicant's Comment
8	**8.5 Circling Descent to a Facility Embedded in a Wind Farm Array** Accessing a facility embedded within a windfarm array with no dedicated access corridor would necessitate the helicopter overflying the array enroute to the embedded HPZf. Based on a turbine assembly height of 920ft (rounded up to 1,000ft) plus the obstacle clearance of 500ft and a cloud base clearance of 100ft, the minimum cloud base required is 1,600feet.  ***NOTE:** Diameter of 3.8nm = Radius of 1.9nm* **Figure 10A** ***Profile View of Minimum Dimensions of Unobstructed Airspace for a VFR Circling Descent and Approach to a Remote Facility located in the centre of a HPZf in a Windfarm Array. (80 kts / Rate 1 Turn)*** The helicopter would be able to approach the area from any direction and, once overhead the facility, commence a Rate One circling descent while remaining visual with the facility. On reaching a height of 500ft the helicopter positions onto the Final Approach Sector, into wind, where the pilot manoeuvres the	This section is not applicable as no platforms are embedded within the wind farm. The term HPZf is not used in aviation regulations or guidance material.

Comment ID	AviateQ Text	Applicant's Comment
	helicopter into a stabilised configuration prior to reaching the Stabilised Approach Point (SAP) at 0.5nm. Assuming the helicopter enters the HPZf at 1,500ft, based on a descent rate of 500ft per minute it would take two minutes and one 360° turn to reach the approach height of 500ft. On departure the aircraft would conduct a circling climb to 1,500ft prior to transiting over the array en-route to destination. However, in the event of an engine failure at TDP there is enough space within the confines of the HPZf to achieve a safe OEI departure and to conduct a circling climb to 1,500ft before exiting the HPZf. However, this would necessitate a single engine transit over the array enroute to destination. As depicted in **Figures 10A** above and **108** below, a HPZf with a minimum diameter of 3.8nm would be needed. This manoeuvre, if ever used, could only be conducted under Visual Meteorological Conditions where the facility and the turbines remain visual at all times. **Note:** Circling descents are not currently practiced by North Sea operators serving the oil and gas industry.	
9	**9.2 IFR Operating Considerations in an HPZf** **9.2.1 ARA Approaches** Airborne Radar Approaches (ARAs) to offshore locations, CAT operations, are covered under EASA Regulations Part SPA, Specific Approval, SPA.HOFO.125. ARAs are a standard practice	The CAA is the regulatory authority not EASA.

Comment ID	AviateQ Text	Applicant's Comment
	applied by helicopter operators when operating IMC offshore the United Kingdom. Crews check the weather before departure and determine if the approach to the facility will involve the ARA procedure. The helicopter offshore ARA procedure may have as many as five separate segments namely the arrival, initial, intermediate, final and the missed approach segments as can be seen from the horizontal and vertical profiles extracted from the EASA regulations. The footprint of an offshore ARA varies slightly between North Sea offshore helicopter operators; primarily the point at which the aircraft commences the ARA approach which for some operators is up to 7nm from the facility. These distances are subject to review amongst the operators to agree on the minimum acceptable distance. As can be determined from the above, an ARA typically calls for a straight, into wind approach. The distances and offsets depicted in the horizontal and vertical profiles show the Initial Fix (IF) at 6nm, a Final Approach Fix (FAF) at 4nm, an Offset of 10^0 at 1.5nm with the Missed Approach Point (MAP) at .75nm. If not visual by the MAPt a climbing turn away from the facility of not less than 30° and not greater than 45° is required.	Although it is typical to fly an ARA directly into wind, a slightly out of wind approach may be conducted. It has been assumed that an approach up to 30^o out of wind may be made providing the drift angle is less than 10^o.
	9.3 Aircraft Operator ARA Minima for Offshore Operations The current aviation service provider stipulates:	The same standard limits for an ARA are applied in the HAR.

Comment ID	AviateQ Text	Applicant's Comment
	Minimum Descent Height (MDH) shall not be less than 50 ft above the elevation of the helideck. The MDH for an ARA shall not be lower than : ▪ 200 ft by day ▪ 300 ft by night The MDH for visual manoeuvring after an ARA shall not be lower than : ▪ 300 ft by day ▪ 500ft by night	A circling approach could be used as mitigation for increasing IMC access but is rarely used by offshore operators and so has not been included in the HAR at this point. In practice a downwind ARA is not feasible due to the limited operating envelope of an airspeed of 60-90kt and a maximum ground speed of 70kts (GM1 SPA.HOFO.125 ARA to offshore locations). So, even applying the minimum airspeed of 60kt would only allow a maximum wind speed of 10kt before the ground speed limit of 70kt was exceeded.
9.4	9.4 Unrestricted Access to a Facility Surrounded by Wind Turbines	This section is not applicable as none of the facilities are surrounded by a wind farm
9.5	**9.5 Engine Failure at ARA Missed Approach Point and Climb OEI to 1,000ft** In the event of an engine failure on reaching the Missed Approach Point (MAPt) the pilot will execute a 30° turn away from the facility and commence a climb at Vv to 1000ft, followed by a Rate One Turn through 180° while continuing the climb to the Minimum Sector Altitude (MSA) i.e. 1000ft above	The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix C: Helicopter Supporting Information Technical Note (Document Reference 9.35.3) demonstrates that the offset at 1.5nm from the installation, and any Missed Approach will be orientated away from the platform.

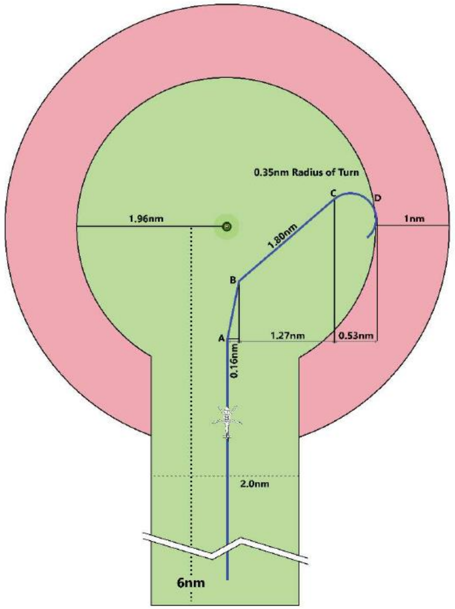
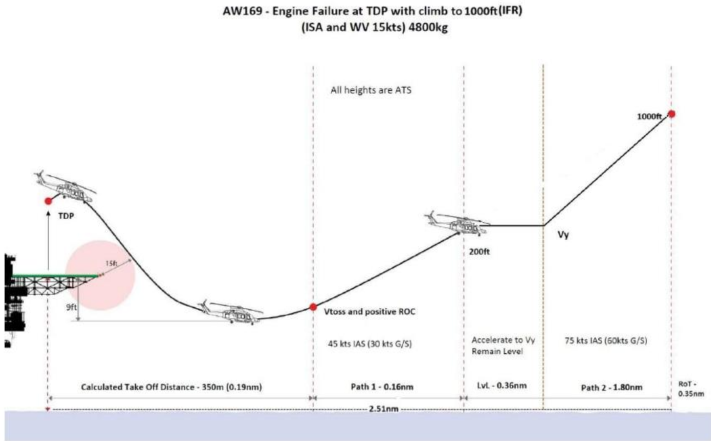
<table>
<tr><th>Comment ID</th><th>AviateQ Text</th><th>Applicant’s Comment</th></tr>
<tr><td></td><td>the height of the wind turbines. The distances required as shown in Figure 13 below equates to a radius of 1.96nm. Adding the 1nm obstacle clearance in IMC brings the total distance required to 2.96 nm.


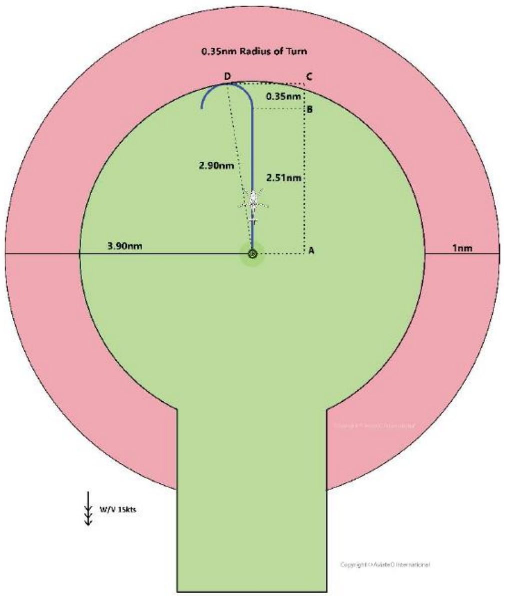
Figure 13
AW169 Distance Required OEI Climb from ARA MAPt to 1000 ft & turn through 180⁰ inside the HPZf</td><td>Therefore, the distance to complete a Missed Approach is always available.</td></tr>
<tr><td>9.6.1</td><td>9.6 Engine Failure at TDP and Climb to 1,000ft in IMC</td><td></td></tr>
</table>

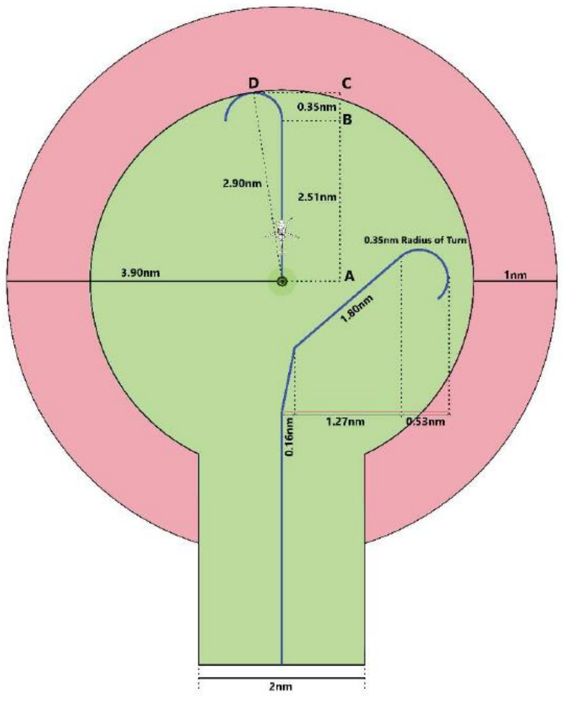
Comment ID	AviateQ Text	Applicant's Comment
	A take-off from a helideck, with an engine failure on rotation at the Take Off Decision Point (TDP), and a climb to 1000ft in IMC is deemed to be the most restrictive case taking up the most distance to achieve a safe departure within the confines of a windfarm array. The distance required to safely execute a continued take off on one engine following an engine failure on rotation at the Take-off Decision Point (TDP) in the AW169 has been calculated based on the following ***(Figure 14A)****:* 1. Drop down height 2. Acceleration from the Take-off Decision Point (TDP) to Take Off Safety Speed (Vtoss) with a positive Rate of Climb (CTO) 3. Path 1 climb from end of CTO to 200ft at Vtoss. 4. Level acceleration from Vtoss to Vy. 5. Path 2 climb from 200ft to 1000ft at Vy. 6. Rate one turn at 1000ft 7. Pressure altitude of 0ft, temperature of 15C, wind velocity of 15kts 8. All heights are Above Take-off Surface (ATS). **Section 1:** Acceleration from TDP to Vtoss and positive ROC (CTO)	Although this section considers an engine failure inside a wind farm, which is not applicable, it does show the calculations AviateQhave applied to an OEI continued take-off. Differences in the distance required are noted. They are due to a difference in take-off mass assumptions, wind and other assumptions. In addition, the AviateQ applies a climb to 1,000ft above helideck height (1,184 ft), and not 1,000ft above sea level, as previously agreed with helicopter operators, resulting in a longer distance. A detailed explanation for the distances required for a range of aircraft mass and wind conditions are shown in The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix C: Helicopter Supporting Information Technical Note (Document Reference 9.35.3). The AviateQ report has incorrectly applied a drag penalty to Flightpath 1. The Flightpath 1 profile requires the landing gear to be lowered, and so the additional drag from the landing gear has already been taken into account in the performance graphs. Therefore, the resulting distance will be shorter than calculated by AviateQ.

Comment ID	AviateQ Text	Applicant's Comment
	▪ 9ft drop down due head wind factor. *(Graph S4T-D15)* ▪ Distance required is 350m or **0.19nm.** (Section 4 – Performance data – OEI Continued Take-off Distance) **Section 2:** Path 1 Climb from end of CTO to 200ft ▪ Speed – Vtoss 45kts IAS (30kts G/S) ▪ Height to climb – 209ft (200ft + 9ft drop down) ▪ Climb at 2 ½ minute power with reduced gradient due to 'Fixed Undercarriage' and 'Life rafts in extended sponsons' ▪ Drag factor – 0.6 (Graph S4-6) ▪ Distance required is 0.16nm (Graph S4-7 and S4-22) **Section 3:** Level Acceleration from Vtoss to Vy at 200' ▪ Accelerating from 45kts to 75kts ▪ Maintaining 2 ½ minute power ▪ Distance required = 660m or 0.36nm (Graph S4-32.) **Section 4:** Path 2 climb from 200ft to 1000ft ▪ Speed – Vy 75kts IAS (60kts G/S) ▪ Climb gradient at MCP with reduced gradient due to 'Fixed Undercarriage' and 'Life rafts in extended sponsons'	This will be flown into wind and so the wind speed of 15kts assumed in the AviateQ Report will result in a shorter distance.

Comment ID	AviateQ Text	Applicant's Comment
	▪ Drag factor – 0.6 (Graph S4-6) ▪ Distance travelled is 1.80nm (S4-9 and S4-43) The total distance required for OEI TDP to 1000ft would be the sum of the 4 sections namely 0.19nm + 0.16nm + 0.36nm + 1.80nm = **2.51nm.**	
9.6.1	**The total distance required for OEI TDP to 1000ft would be the sum of the 4 sections namely 0.19nm + 0.16nm + 0.36nm + 1.80nm = 2.51nm.** **Rate One Turn at 1000 ft (IFR)** The total distance required from TDP / OEI to 1000ft and 180° turn taking into consideration the displaced apex of the Rate one Turn **= 2.90 nm. *(Figure 14B)*** Minimum distance required would need to include the legal obstacle clearance requirement of 1nm for IFR flight and therefore minimum distance required is **3.90nm.** On completion of the turn the aircraft will continue to climb to the Minimum Sector Altitude (MSA) i.e., 1000ft above the tips of the turbine rotor blades. Note: the MSA will vary depending on the height of the assembly.	For the reasons stated above, these distances are considered to be excessive. In particular: ▪ The maximum aircraft mass of 4,800kg used by AviateQ in their calculations is unlikely. A mass of 4600kg and lower is more probable, as there is no offshore refuelling capability the helicopter's take-off mass will continue to decrease as the flight progresses. If eight passengers are carried from Blackpool Airport to CPC-1, then any subsequent take-offs from CPC-1 will be at 4,650kg or lower. A fuller explanation of the take-off mass is shown in Section 4.3 of The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix C: Helicopter Supporting Information Technical Note (Document Reference 9.35.3). ▪ Some minor errors on the drag penalty to apply has been made.

Comment ID	AviateQ Text	Applicant's Comment
	 **Figure 14A** ***AW169 Profile View Distance Required OEI Climb to 1,000ft***	▪ A major difference is that the climb should be to 1,000ft above sea level and not 1,184ft (1,000ft plus the height of the CPC-1 helideck). Applying the AviateQ methodology, a shorter distance will be required from any other helideck in the Morecambe Gas Field as they have lower helidecks than CPC-1. The Applicant has calculated the distances required for take-off in Section 4 of The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix C: Helicopter Supporting Information Technical Note (Document Reference 9.35.3).

Comment ID	AviateQ Text	Applicant's Comment
	 **Figure 14B** ***AW169 Plan View Distance Required OEI Climb to 1,000 ft and turn in IMC inside the HPZf*** As can be seen from **Figure 15** below, the distance to execute the OEI missed approach procedure is accommodated withing the minimum airspace required (3.90nm) for the continued take-off after engine failure at TDP from an elevated helideck.	

Comment ID	AviateQ Text	Applicant's Comment
	 Figure 15 *AW169 Engine Failure at TDP versus Engine Failure at MAPt Distances*	
9.7	**9.7 Circling Approach Following a Downwind ARA** The operating minima for a downwind ARA and a subsequent circling approach procedure	Downwind ARAs are not considered in the HAR as their operational envelope is very limited. Maintaining a ground speed no greater than 70kts would only permit a 10kts

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	is a MDH of 300ft or deck height plus 100ft during the day and 500ft or deck height plus 100ft during the night whichever is the greater. The decision range increases from 0.75nm to 1nm day and 1.5nm at night. If visual reference is lost while circling due to for example inadvertent entry into cloud, irrespective of the location of the aircraft in the circling area, the handling pilot must execute a missed approach, climbing until the MSA is reached. A straight in ARA is the safest procedure that simultaneously brings the helicopter to a MAPt of 0.75nm at 200 feet with the aircraft in a stabilise approach configuration. A straight in ARA to an intermediate structure provides the same level of safety (0.75nm at 200 feet) but a low-level shuttle to the destination is unlikely since the operating minima stipulates a higher cloud base. The risks associated with a circling approach in poor visibility are much higher than that for other types of approach. **Note 1:** Inadvertent flight into IMC occurs when an aircraft is operating in visual conditions and unexpectedly enters an area of low or zero visibility such as low cloud or snow showers. If the aircraft is at low level (below 500 feet) having passed the MAPt on an approach to land on an offshore helideck, this has the potential to be a hazardous condition and would necessitate an immediate go around.	downwind component at the minimum indicated airspeed of 60kts. GM1. SPA.HOFO. 125 (f) (3) states: "Although the airspeed should be in the range of 60–90 KIAS during the final approach, the ground speed, after due allowance for wind velocity, should not be greater than 70kts."

Comment ID	AviateQ Text	Applicant's Comment
	Note 2: Visual approaches in poor visibility increase pilot workload and increase the risk of pilot disorientation; this practise has resulted in several helicopter accidents in the North Sea.	
10.1.a	**10. Conclusion** **10.1 VFR Operations AW169** A facility embedded within a wind farm array could be accessed: **a)** Via a direct, straight line of sight, unobstructed 1,600m Helicopter Protected Zone Corridor (HPZc) (Figure 2). It is unlikely that, given the wind speeds experienced in the operating area, any crosswind components in the HPZc would impact day to day operations. For the helicopter to safely manoeuvre onto an approach to the facility the radius of the unobstructed Helicopter Protected Zone (HPZf) surrounding the facility (Figure 6) would need to be not less than 1.9nm. The space available will accommodate an engine failure on departure from the facility, the OEI climb to 500ft as well as a turn within the confines of the HPZf **(Figure 7B)**. Remaining clear of obstructions is always assured since exiting the area would be via the unobstructed corridor. Operations would not be permitted with a horizontal visibility of less than 5Km and a cloud base **lower than 700 feet**; or	The helidecks near the Morecambe wind farm are not "embedded" but external to the wind farm. The concept of a HPZc is not in regulations or industry guidance. The distance of 1.9nm is not agreed. This distance applies a pre-stabilisation point before the stabilisation point required. Current examples of operations and consented DCOs contest this figure.

Comment ID	AviateQ Text	Applicant's Comment
10.1.b	**b)** by approaching the Helicopter Protected Zone (HPZf) from any direction **(Figure 10A)** and, once overhead the facility, conducting a Rate One circling descent to 500ft while remaining visual with the facility. On reaching a height of 500ft, for the helicopter to safely manoeuvre onto an approach to the facility the radius of the unobstructed Helicopter Protected Zone (HPZf) surrounding the facility **(Figure 10B)** would need to be not less than **1.9nm**.	This considers a circling descent, which is not relevant as it is not a flight profile used offshore and would only apply to a helideck encircled by a wind farm, which will not apply as the Morecambe Offshore Windfarm is located to the south and south-east of the South Morecambe Platforms and to the east of the Calder Platform (i.e. there is unobstructed airspace around the platforms in all other directions)
10.1.2	**2)** A facility located adjacent to one side of a windfarm array **(Figure 8)** would need to be not less than **1.9nm** distance away from the windfarm boundary. The space available will accommodate an engine failure on departure from the facility **(Figure 9)**, the OEI climb to 500ft as well as the turn away from the windfarm boundary.	The distance of 1.9nm is not supported by current operations and consented DCOs. In the AviateQ report calculations a take-off mass of 4800kg has been assumed, which is an absolute worst case approach and not likely to be applicable for many flights. The Applicant's take-off distances are presented in The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix C: Helicopter Supporting Information Technical Note (Document Reference 9.35.3).
10.1.3	**3)** Positioning a mobile such as a workover barge / accommodation unit / flotel immediately adjacent to the main facility embedded within a wind farm array or a main facility located adjacent to one side of a windfarm array boundary would not impact on the overall unobstructed airspace	Not relevant as no helidecks are located inside the wind farm.

Comment ID	AviateQ Text	Applicant's Comment
	requirement. However, positioning a mobile away from the main facility (which could be as far as 100m away) could result in operating restrictions being imposed by the helicopter operator. Any such restrictions would depend on the wind speed and direction relative to: a) The distance the mobile has been offset away from the main facility embedded within a wind farm arrav. b) The positioning and the distance the mobile has been offset away from the main facility located adjacent to a windfarm boundary. Positioning the mobile further away from the boundary would not impact the unobstructed airspace requirement. **Note:** the orientation of the mobile relative to the main facility could result in operational restrictions as per current practice. This would be evaluated by the facility owner and the helicopter operator during the planning stage.	
10.2.1	**10.2 IFR Operations – AW169** 1) Due to the variations in wind directions, to ensure unrestricted access to a facility within a wind farm array in IMC, the minimum unobstructed airspace around the facility would result in a HPZf with a minimum radius of 7nm allowing for an MSA above 1500ft (due to wind turbine height).	Not relevant as no helidecks are located inside the wind farm. Although no helidecks are located inside the wind farm, the Applicant has proposed a take-off corridor to the southwest of the South Morecambe Platform which would increase IMC and night access. This is presented in The Applicant's

Comment ID	AviateQ Text	Applicant's Comment
	2) The airspace requirement could be reduced by establishing a 2nm wide, line of sight, IFR corridor oriented 210° into the prevailing wind and extending from the centre of the HPZf (CPCl facility) to a distance of 6* nm. It must be noted that changes in wind speed and direction have an impact on the aircraft drift angle and aircraft operator limitations would apply. 3) The current aircraft service provider requires a 7nm approach path which starts at the Minimum Sector Altitude (MSA). This varies from 1000ft to 1700ft depending on where the approach starts. The space required for a continued take-off OEI when operating an AW169 is the most restrictive manoeuvre requiring an IFR HPZf with unobstructed airspace 3.90nm around the facility (Figures 14A and 14B). This distance would accommodate the space required (Figure 13) to execute an engine failure at the MAPt following an ARA approach. An IFR HPZf with 3.90nm of unobstructed airspace around the facility would, subject to wind speed and direction being within operating limits in the IFR corridor leading into the HPZf, also accommodate a downwind ARA culminating in a circling approach to land. It is to be noted that not all aircraft operators permit this manoeuvre.	Response to Spirit Energy Deadline 1 Submissions Appendix B: Helicopter Access IMC Corridor (Document Reference 9.35.2). The Applicant has provided a detailed analysis on the approach and take-off distance required in The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix C: Helicopter Supporting Information Technical Note (Document Reference 9.35.3).

<table>
<tr><th>Comment ID</th><th>AviateQ Text</th><th>Applicant’s Comment</th></tr>
<tr><td>10.3</td><td>IFR Operations-AW139
1) The AW139, having better performance capabilities than the AW169, will be able to operate within the confines of the space determined suitable for the AW169.</td><td>The Applicant notes this comment.</td></tr>
<tr><td>10.4</td><td>10.4 Comparison of Airspace Requirements
<table>
<tr><th colspan="4">AW169/AW139 Airspace Requirements by Type of Approach
(Based on most restrictive helicopter type)</th></tr>
<tr><th>Type of Approach into HPZf</th><th>Minimum Cloud Base</th><th>Minimum HPZF Radius</th><th>Notes</th></tr>
<tr><td>VFR with a corridor</td><td>700'</td><td>1.9nm</td><td>Corridor width of 1600 meters</td></tr>
<tr><td>VFR without corridor</td><td>1600' (Based on turbine height)</td><td>1.9nm</td><td>Circling Descent and Circling Climb required</td></tr>
<tr><td>VFR with adjacent windfarm array</td><td>700'</td><td>1.9nm</td><td></td></tr>
<tr><td>IFR with corridor requiring an ARA</td><td>200' or deck height plus 50' whichever is the highest</td><td>3.9nm</td><td>Corridor width of 2nm</td></tr>
<tr><td>IFR without corridor requiring an ARA</td><td>200' or deck height plus 50' whichever is the highest</td><td>7.0nm - 9.0nm</td><td>Depending on MSA and helicopter operator.</td></tr>
</table>
<table>
<tr><th colspan="3">Minimum Distance Requirement Comparison for OEI departure
AW169 and AW139
(Distance includes required obstacle clearance requirements)</th></tr>
<tr><th>Type of Manoeuvre</th><th>AW169</th><th>AW139</th></tr>
<tr><td>Engine Failure at TDP - VFR (Climb to 500ft)</td><td>1.84 nm</td><td>1.33 nm</td></tr>
<tr><td>Engine Failure at TDP - IFR (Climb to 1000ft)</td><td>3.90 nm</td><td>3.14 nm</td></tr>
</table>
</td><td>This summarises the distances within the AviateQ report.

The Applicant summarises the approach and take-off distances in Tables 4.1, 4.2 and 4.3 in The Applicant's Response to Spirit Energy Deadline 1 Submissions Appendix C: Helicopter Supporting Information Technical Note (Document Reference 9.35.3).</td></tr>
</table>

Comment ID	AviateQ Text	Applicant's Comment
	AW169/AW139 Airspace Requirements by Type of Approach (Based on most restrictive helicopter type)	

Type of Approach into HPZf	**Minimum Cloud Base**	**Minimum HPZF Radius**	**Notes**
VFR with a corridor	**700'**	**1.9nm**	**Corridor width of 1600 meters**
VFR without corridor	**1600' (Based on turbine height)**	**1.9nm**	**Circling Descent and Circling Climb required**
VFR with adjacent windfarm array	**700'**	**1.9nm**	

<table>
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<tr><td>IFR without corridor requiring an ARA</td><td>200' or deck height plus 50' whichever is the highest</td><td>7.0nm - 9.0nm</td><td>Depending on MSA and helicopter operator.</td></tr>
</table></td><td></td></tr>
<tr><td>11</td><td>11 TURBINE INDUCED TURBULENCE
Turbine induced turbulence, caused by the wake of a wind turbine which extends down-wind behind the wind turbine blades and the tower, needs further consideration. CAP 764 Section 2.51 through to Section 2.61 cover the issue of turbulence also stating that, due to different parameters that need to be taken into consideration, it is difficult to scale up wake results from a small to large wind turbine. Work carried out by Liverpool University referenced in CAP 764 was based on small wind turbines of less than 30m rotor diameter (RD).</td><td>The work referenced covered general aviation aircraft. For aerodynamic reasons, general aviation (light aircraft) have a low wind loading and so are much more susceptible to gusts and turbulence than helicopters.

Further work has been conducted by the University of Liverpool and NLR (Netherlands Aerospace Centre) on the effects of wind turbine wakes on helicopter handling qualities. These have not identified any major handling issues beyond typical offshore turbulence, such as approaching a helideck.</td></tr>
</table>

Comment ID	AviateQ Text	Applicant's Comment
	CAP 764 2.60 states, "LIDAR field measurements on a WTN250 wind turbine at East Midlands Airport, UK, indicated that statistically, the wake velocities recovered to 90% of the free stream velocity at the downstream distance of 5 RD". CAP 764 2.60 states," Based on the models described in the Liverpool University Research Paper, schematics of the wake region for small wind turbines are given in the following figures. The figures show the zone where wake encounter has potential to cause severe impact on the encountering GA aircraft".	It is understood that no incidents (Mandatory Occurrence Reports) have been reported due to turbulence in wind farms. Discussions with helicopter pilots working inside wind farms has not yielded any further evidence of turbulence being an issue. This is the subject of ongoing research and continues to be monitored. In strong winds the energy extracted by the turbines increases and so the wake is not directly proportional to the wind speed. Furthermore, higher wind speeds improve the helicopter climb gradient as the ground speed is lower for a given airspeed, so helicopters can turn further away from the turbines.

3 References

i UK Civil Aviation Authority (2010). CAA Paper 2010/01: The SBAS Offshore Approach Procedure (SOAP). https://www.caa.co.uk/our-work/publications/documents/content/caa-paper-2010-01/

ii SPA HOFO - specific approval for helicopter offshore operations | Civil Aviation Authority (caa.co.uk)