Appendix 15.1

Helicopter Navigation Report

STRATEGIC INFRASTRUCTURE DEVELOPMENT

APPLICATION TO AN BORD PLEANÁLA

(REG NO. PL04.PA0045)

RINGASKIDDY RESOURCE RECOVERY CENTRE,
RINGASKIDDY, COUNTY CORK

REQUEST FOR ADDITIONAL INFORMATION

HELICOPTER NAVIGATION

10 MAY 2017

Contents **Page**

List of Figures	3
Qualifications and Experience	4
Executive Summary	7
Introduction	9
Request From An Bord Pleanála	10
Scope	11
Methodology	13
Current Aviation Environment and Constraints	17
Baseline Aviation Environment	21
The Proposed Indaver Facility and Stack	36
Aw 139 Aircraft and Performance	39
Haulbowline Navigational and Safety Requirements	44
Low gradient flight paths	46
RFI - Further comments on the Department of Defence Submission	52
Exclusion Zone	56
Additional Procedures	59
Conclusions	64
References	66
Annex A – Devonport/ RNAS Culdrose	68
Annex B – Helicopter Landing Sites	74

List of Figures

List of Figures	Page
Figure 1 – available helicopter landing sites on Haulbowline	21
Figure 2 – Aerial image of Haulbowline looking south	22
Figure 3 – the line of pylons running from HNB	24
Figure 4 – Ordnance Survey map showing the line of pylons (plan view)	24
Figure 5 – the climb out from the sports pitch as viewed from ground level on the shoreline of Haulbowline.	26
Figure 6 – the pylon on Rocky Island	27
Figure 7 – the pylons running east/west along the ridgeline	27
Figure 8 – other obstacles in the vicinity of Haulbowline	28
Figure 9 – the climb out from the Main Square as viewed from ground level on the shoreline of Haulbowline.	29
Figure 10 - Side Profile of Turbine Turbulence	31
Figure 11- turbulence areas behind wind turbines	32
Figure 12 – vertical obstructions in the immediate vicinity of the Indaver site	38
Figure 13 - Rate of Climb Profiles AEO at MAUW 6400kg	41
Figure 14 - Rate of Climb Profiles OEI at MAUW 6400kg	42
Figure 15 - Distances to the stack avoidance zone from the HNB landing sites	48
Figure 16 – Join/Departure procedure for HNB	50
Figure 17 – Wind Rose - Cork Airport 1962 – 2014	54
Figure 18 – Wind Rose - Cork Airport 2008 – 2014	55
Figure 19 – a generic/typical SHOL	61
Figure 20 - helicopter operating with the LE Ciara	62
Figure 21 - helicopter approach to the LE Eithne	62
Figure 22 – Weston Mill Lake Devonport.	70
Figure 23 – Weston Mill Lake Devonport.	70
Figure 24 – Royal Naval Air Station Culdrose	73

1. Qualifications and Experience

DBS Consultation Ltd and Jensen Marks Aviation Consultants Ltd have been engaged by Indaver to consider the matter of helicopter navigational safety in the vicinity of Haulbowline Naval Base, Cork, in respect of the concerns raised by the Department of Defence (DoD)/Irish Air Corps (IAC).

DBS Consulting is a company specializing in aviation safeguarding advice within the context of extant aviation Regulation and Guidance. With the downturn in the wind industry within the UK Shane Savage ended his employment within Wind Farm Aviation Consultants Ltd (WFAC) and moved to DBS Consulting Ltd which has been established to provide project management advice in the wider aviation safeguarding context and around the globe.

Jensen Marks are a company specializing in helicopter operations providing subject matter expertise to companies requiring the complete spectrum of specialist knowledge in defence and civil aviation related areas.

The two authors of this report have extensive experience in helicopter operations and the operations of, to and from Helicopter Landing Sites (HLS):

Mark Hourigan (MinstLM)

Mark Hourigan joined the Royal Navy, after completing his A levels, as an Engineering Artificer (Mech and Elec) and Ship's Diver before transferring to Aircrew Officer Duties in 1992 at Britannia Royal Naval College, Dartmouth.

He completed operational Commando Sea King (Mk4) helicopter training in 1995 and completed several tours of duty with 845 and 846 Naval Air Squadrons in Northern Ireland, Bosnia and Iraq, latterly as the overseas Commanding Officer.

Mark has over 4000 hours of flying experience having flown in some of the most challenging conditions throughout his operational career. He is a Qualified Warfare and Night Vision Goggle Flying Instructor and was appointed as staff officer in the Maritime Warfare Centre and the Ministry of Defence where he was responsible for the authorship and delivery of UK/NATO Rules of Engagement and campaign Strategic Directives.

After completing is commission in 2009 he set up Jensen Marks Ltd providing bespoke consultancy for companies requiring aviation support and solutions in the UK, US and Sub-Saharan Africa.

He is a current freelance Captain holding an Airline Transport Pilots Licence (ATPL). He maintains several type ratings on Sikorsky (S76) and Euro-Copter/Airbus (H155/AS355) helicopters.

Shane Savage BSc

Previously the Managing Director of Wind Farm Aviation Consultants Ltd, but with the large-scale drawdown in the UK wind industry, Shane has now moved to DBS Consulting Ltd which has been established to provide project management advice in the wider aviation safeguarding context around the globe. He is currently working aviation safeguarding on projects in the Bahamas, North America and Europe and on both civil and military issues.

In over 28 years in the Royal Navy Shane had over 25 years' experience in operational Air Traffic Control, (ATC), Fighter Control (FC) and Air Defence operations and Danger Areas Management. As a warfare officer his specialist training was in amphibious warfare and, specifically, helicopter support to the battlefield. He was also a qualified Helicopter Flight Deck operations officer for ships. Before becoming a staff officer for several tours, his last major seagoing appointment was as Lt Cdr (Flying (the officer in charge of flying)) on the commando helicopter aircraft carrier, HMS Ocean.

Shane's last tour in the Royal Navy was as Head of Aviation Operations Support for the Royal Navy Fleet Air Arm. This included the roles of the Head of Safeguarding for Royal Navy aviation infrastructure, Aviation Operations Support, the safe operation of all Naval Helicopter Landing Sites (26 in total within the UK), the safe operation of all Naval Danger Areas and Exercise Areas, Flight Deck operations policy, regulation and service delivery at 4 airfields, 1 Area Radar Unit, 3 Aircraft Carriers and all RN operations throughout the world.

From 2008 – 2010 he served in the Joint Air Land Organisation HQ Air Command (JALO) as the Staff Officer for the Concepts and Doctrine for Air Land Integration. He was the UK MOD lead for the development and assurance of Forward Air Controller Close Air Support Tactics, Techniques and Procedures in addition to having lead responsibility for the development of air battlespace management doctrine and instructional courses. As the UK representative to the US Joint Forces Command's Joint Fires Organisation he was responsible for the UK input on Air Battlespace Management and aviation support to the battlefield. Additionally, he was UK representative to the US/NATO/Coalition Joint Close Air Support Executive Steering Committee with respect to Secure Data Links in Airspace Management.

During his career he has been a member of the following regulatory and advisory bodies:

- UK Airspace Strategy Steering Committee
- UK CAA National Air Traffic Management Advisory Committee
- CAA/MOD National Flight Safety Committee
- CAA Danger Areas User Group
- MOD Airspace Requirements Review Team
- National UK IFF and SSR Committee
- Defence UK IFF and SSR Committee
- MOD Wind farm Policy Group
- Military Users Airspace Co-ordination Team
- MOD Air Command and Control Programme Delivery Board
- MOD ATC Aviation Safety Board
- MOD Air Traffic Management Performance Criteria Working Group
- MOD UAV Airspace Design Working Group
- USA Joint Forces Command Executive Steering Committee on Air Battlespace Management, Close Air Support and Digital Data links
- MOD Mode S Working Group
- MOD/NATS Joint Future Airspace Design Team
- MOD/CAA Flexible Use of Airspace Policy Group
- UK AirProx Board
- UK Air Safety Initiative Wind farms Working Group

2. Executive Summary

2.1 The introduction of the proposed waste to energy plant at Ringaskiddy does not pose any additional flight safety consideration to the safety of Irish Air Corps helicopter operations from Haulbowline Naval Base (HNB).

2.2 Nor should the proposed Waste to Energy (WtE) plant, or the proposed stack at that site, have any additional effect on the flight profiles or paths which should be currently flown from Haulbowline given the existing obstructions, and flight safety considerations, in place.

2.3 The authors do not agree with the DoD assessment of the Indaver site as a threat to aviation.

2.4 There is nothing in International Regulation or Guidance which would preclude the operation of a stack in the area of a helicopter landing site.

2.5 Regardless of the Regulations the IAC operate to they should never be in such close proximity to the stack such that the plume could affect the flight of the airframe.

2.6 The existing aviation environment has existing, significant constraints on helicopter operations the mitigation for which should more than account for any possible effect that the WtE could have. The development of the WtE will not require any additional operating restrictions on the use of the landing sites at Haulbowline.

2.7 Flight safety, or aviation safety, is the descriptive term for the theory, investigation and prevention of aircraft and flying incidents and accidents through Guidance, Regulation, Training and Education. Everyone can, and should, be involved in flight safety from the pilots, engineers and ground crew through to infantry or commercial fare paying passengers and to those living on the ground in the vicinity of airports, helicopter landing sites and flights. Flight safety underpins modern aviation: it is paramount and it is the authors' opinion the importance of flight safety should not be underestimated nor should it be mis-represented for personal, political or commercial gain. The authors of this report have over sixty years combined experience in military and civil aviation during which they have constantly upheld the highest possible standards of flight safety and adherence to the requirements of that flight safety. Neither would advocate anything which they deemed, in any way, to compromise those standards.

2.8 The authors of this report have considered the DoD objections contained within their two submissions to An Bord Pleana (the Board).

3. Introduction

3.1 Indaver (Ireland) have applied for permission to construct a waste to energy plant at Ringaskiddy, Co. Cork to which objections, on the grounds of possible implications for aviation safety have been made by the DOD, dated 22 April 2016 and 11 May 2016, and submitted to An Bord Pleanála.

3.2 The aim of this report is to address the matters relating to the navigation and safety of helicopters using HNB with respect to the proximity of the proposed stack.

3.3 It is recognised that the main user, in terms of aviation at HNB, is the Irish Air Corps.

3.4 In addressing the requirement for further information in respect of aviation the report will consider, but not be limited to, the issues as perceived by the DoD and as articulated in their submissions to the Board on the application.[1]

[1] Department of Defence Submission dated 22 April 2016 and Department of Defence Reply to Indaver Reports dated 11 May 2016.

4. Request From An Bord Pleanála

4.1 An Bord Pleanála [the Board] has requested that the applicant respond to the contents of the submission from the Department Of Defence dated 11th May 2016 helicopter activity at Haulbowline Naval Base (hereafter, HNB)

4.2 The Board have requested that the following matters should be addressed:

- The matters raised by the Department of Defence,
- Low gradient flight paths on take-off from and landing at the naval base,
- The impact of local climatic conditions including occasions of atmospheric pressure inversions in Cork Harbour on the character of the plume from the proposed stack, and;
- The possible requirement, based on best international practice, for an exclusion zone around the naval base.

5. Scope

5.1 The paper will:

- First, consider the existing aviation environment as the baseline in which the IAC operate from Haulbowline.
- Second, it will consider if there are any implications for flying operations in the area as a result of the proposed stack.
- Third, the report will consider the navigational and safety conduct of helicopters operating from HNB.
- Finally, it will consider the remaining specific points raised within the RFI.[2]

Relevant Guidance

5.2 There are no published procedures in the public domain for operations at Haulbowline and the description of the flight paths given in the most recent DoD submission remains the only source of information on HNB operations available to the authors.

5.3 In lieu of definitive and detailed flight operations data at HNB this paper will rely on International Regulation, Guidance and practice on the generic operations, which the DoD states occur at the HLS, in addition to the evidence given by the DoD at the Oral Hearing[3]. Open source information such as Google Earth Pro and Integrated Air Information Publications (IAIP) issues by the Irish Aviation Authority (IAA) have been used to research regulations, generate accurate pictorial references and develop layered overviews demonstrating distances, bearings and tracks where appropriate.

5.4 We are aware of Mr Graham Liddy's report but have not contributed to that in any way; the reports should be seen as being completely independent of one

[2] The impact on local climatic conditions on the plume and stack is not considered to be an aviation matter and is not addressed within this paper.

[3] 11 May 2016.

another and, at the time of writing, the authors of this paper have not seen Mr Liddy's submission. We have been made of the conclusions within that report and which would seem to be entirely in keeping with the authors of this report's expectation on avoidance areas in aviation against such facilities as the National Maritime College, pylons, turbines and other existing developments which represent a hazard.

5.5 The findings of the AWN report into site specific effects from the proposed stack have been used to inform the discussions on flight paths and profiles.

5.6 The report has been written in plain language and, as far as possible, avoids aviation and technological terminology. However, when necessary, such written language is used although this is kept to a minimum.

6. Methodology

6.1 This report will describe the existing environment and consider helicopter operations in that environment. It will then consider the proposed development, in particular the stack/plume, and then consider if there is any potential for additional effects from the proposed development on existing operations.

6.2 The report has been completed by means of a desk based assessment of available information, combined with a visit to Ringaskiddy.

6.3 In order to consider the effect on the operations at the naval base, as envisaged by the DoD, it is necessary to define the extent of the actual objection submitted by the DoD. That objection has expanded from that originally submitted[4]. In that original objection the IAC were singularly concerned with winds from a southerly direction[5] which, in their view, would have an effect on helicopter operations, in such weather conditions, to the landing site on Haulbowline Island or to Spike Island[6].

> *"……….which would result in no possible operations to the Naval Base during Southerly Wind conditions"*

6.4 In terms of aviation the DoD were concerned only with the potential for effects from the plume and the IAC considered that the potential for effects from any plume (visible or invisible) could force them to impose a local no-fly restriction around the site with additional restrictions on operations to the naval base. There were no other aviation concerns listed in the first submission from the DoD.

[4] Department of Defence Submission dated 22nd April 2016.
[5] Department of Defence Submission, Waste to Energy Facility, Ringaskiddy, Co. Cork (Ref 04.PA0045), 22nd April 2016, page 1, final paragraph.
[6] It is understood that Spike Island is now owned by Cork County Council and is in use as a tourist attraction; the possible military use for helicopter landings and departures is not in the public domain. As such, the assessment of the stack on helicopter operations will focus on Haulbowline but it can be assumed that there will be a direct read across to any operation undertaken from Spike Island.

6.5 During the Oral Hearing the DoD submitted an expanded objection which now includes much more by way of perceived effects on helicopter operations, and in all winds, and highlighting the performance of the AW139 in the described roles. For comparison and clarity understanding the aircraft performance and profiles detailed in this paper will focus on the same airframe.[7]

6.6 It should be understood that the conduct of flying and operating helicopters varies between services, institutions and individuals but, in all cases, it can be assumed that participants will adopt sound airmanship with respect to taking off and landing in the vicinity of hazardous obstacles.

6.7 There are no statistics in the public domain detailing the current level of activity at HNB; the DoD statement that the HLS is used to facilitate different aviation functions such as Maritime Counter Terrorism (MCT), load lifting and flying training is accepted.

6.8 There is no information in the public domain as to whether the Naval Base or IAC possesses or maintains any pilot instructions, whether locally produced or officially researched, pertaining to the use of the landing site(s).

6.9 All overlaid data points have been referenced to ground level for consistency.

6.10 In aviation a variety of units are used for measurement in either the vertical or horizontal planes; altitudes and heights can be measured in feet (ft) or metres (m), and distances can be measured in metres (m), kilometres or nautical

---

[7] It is worthy of note that, whilst the AW139 might be the largest helicopter in the IAC fleet of aircraft, under international designation based on Maximum Take Off Weight (MTOW) it would be classed as "Intermediate" or "Medium" and not "Large". The Augusta Westland specification, as the manufacturer, for the aircraft describes the airframe as an Intermediate sized helicopter and not "large" as the IAC classify it in their most recent submission (paragraph 2).

miles (nm). Altitude will be referenced as above mean sea level (amsl) and heights will be referenced as above ground level (agl), where applicable.

6.11 Wind Farm Aviation Consultants Limited, in their submission to the Oral Hearing have highlighted that Irish military air bases, personnel and flight operations are regulated in accordance with regulations established by the Director of Military Aviation (GOC Air Corps), which are not required to comply with Irish Aviation Authority Regulations which are based on International Civil Aviation Organisation (ICAO) Standards and Recommended Practices (SARPS)[8]. In their most recent submission the DoD agree with this statement and highlight that they are not bound by civil aviation rules but operate under Irish Air Corps Air Regulations Manuals under the Defence Acts. In the absence of any detail as to what those military Regulations actually permit in relation to separation standards, this paper will assume that:

"*the policy of the GOC Air Corps to operate to best practice civil aviation rules when possible*"[9]

would require adherence to the civil separation standards.

6.12 The Irish Aviation Authority IAIP stipulates the following minimum distances:

"(f) Except when necessary for take-off or landing, or except by permission from the competent authority, a VFR flight shall not be flown:

1. over the congested areas of cities, towns or settlements or over an open-air assembly of persons at a height less than 300m (1000ft) above the highest obstacle within a radius of 600m from the aircraft;

2. elsewhere than as specified in (1), at a height less than 150m (500ft) above the ground or water, or 150m (500ft) above the highest obstacle within a radius of 150m (500ft) from the aircraft such other height as would permit, in the event of the failure

[8] Wind Farm Aviation Consultants Limited, Indaver Ringaskiddy – Department of Defence Objection, dated 3rd May, footnote, page 3.
[9] Department of Defence Reply to Indaver Reports dated 11 May 2016, paragraph 3.a.

of a power unit, a landing to be made clear of the area without undue hazard to persons or property, whichever height is greatest."

6.13 SI72/2004 Irish Aviation Authority (Rules of the Air) Order 2004 (et al) states that the minimum heights that can be flown include:

"………...closer than 150metres (500ft) to any person, vehicle, vessel or structure,…...at a height less than 150 metres (500ft) above the ground or water."

6.14 It is important to note that the distance of 150m (approximately 500ft)[10],[11] is measured in any direction, not just the vertical plane and, under civil Regulation, pilots are required by law to plan their flights in such a way that they do not fly closer than 150m (500) feet to any obstacle ***except*** when landing or taking-off in accordance with normal aviation practise; this exemption applies to aircraft in the visual circuit (although good airmanship would dictate that any vertical obstacle is not directly overflown.

6.15 The definition of "landing" and "taking off" can vary depending on height, aircraft attitude and operating authority; at what point an aircraft inbound to Haulbowline is said to be in the landing phase or, after wheels have left the ground, to still be in the take-off phase, will be a matter for GOC Air Corps policy.

[10] In some instances IAC Regulations would seem to require a minimum of 2 nautical miles separation from obstacles when the weather conditions indicate that the obstacle cannot be overflown legally and safely. .

[11] International Regulation, which are reflected in the IAA IAIP, actually state that the separation criteria is 150m (500ft); for the purposes of aviation they are regarded as the same.

7. Current Aviation Environment and Constraints

7.1 When considering the use of the HLS it might be useful to outline a generic description of how helicopters operate from such facilities and based on International Best Practise. Different aircraft types will vary in the actual procedure depending on engine performance, single/twin engines, weight, civil/military but it might be useful for understanding to expand on flight profiles and procedures; the actual performance of the AW139 is discussed in greater detail in the report[12].

7.2 The HLS in use must be large enough to accommodate the helicopter type's specific performance techniques and limitations set out in the Flight Manual and with sufficient space to ensure that there is no danger to aircraft or property or people in the immediate vicinity of the helicopter downwash effect. Helicopter downwash can have a considerable effect on nearby structures and people and the ideal minimum size of the HLS will also be described in the Flight Manual for the aircraft type under consideration.

7.3 It can be assumed that the take-off and landing profiles will be in accordance with the aircraft's Flight Manual. For take-off the aircraft is climbed into a low hover and then accelerated close to the ground until the safe climb speed (about 40/50kts) is reached, at which stage the aircraft is climbed away maintaining this speed. The take-off distance is usually detailed in the performance section of the Flight Manual from the hover to 100 feet above the take-off point (assuming nil wind). The distance varies with aircraft type. It is assumed that in the event of a power unit failure, if the pilot is not in a configuration to continue on one engine, that the ensuing forced landing would be made without any significant changes in aircraft direction being attempted. Above 100 feet the pilot is able to manoeuvre progressively more easily with increasing height above the surface to select a suitable, clear space for a forced landing.

[12] The Irish Air Corps were the first military operator of the civilian version of the AW139; a later militarised version (the AW139M) has subsequently been produced. They are largely the same airframe and this report makes no distinction between the two.

7.4 Wind direction is an important consideration for helicopter operations as most critical stages of flight are conducted into wind. Aircraft operating at higher all-up weights and/or with limited power margins will certainly require a landing or take off into wind, as it offsets the power required to conduct that stage of flight, but it should be understood that crosswind and downwind operations are also achievable based on helicopter performance. For both fixed and rotary wind aircraft there is an element of leeway which can be made and which is the crosswind limitation for the airframe (the acceptable limits are defined in the Flight Manual for every airframe). Aircraft departures from airports (civil or military, fixed or rotary wing) are rarely exactly aligned directly into wind but will have an element of a crosswind; for the AW139 the maximum crosswind that is acceptable is 20kts[13]. Once in forward flight the aircraft can manoeuvre irrespective of wind direction.

7.5 It is also important to understand that wind speed offers the most benefit during the initial take off or final landing stages of a flight. Outside of these flight stages, when appropriate safety speeds have been established (in excess of 40kts for take-off), the wind direction becomes less critical. As such, aircraft headings can be altered to accommodate for the need to change flight direction when and where required.

Take-Off Profiles.

7.6 The intended departure flight path is generally conducted into wind, but this can be varied dependent on performance criteria and power available of the helicopter. Downwind departures are used when there are limited options into wind and only ever performed when there is sufficient power margin to conduct the manoeuvre. Into wind take offs are deemed to end at a point where the aircraft can 'fly away' safely with One Engine Inoperable (OEI) following a critical power failure. The fly away position is determined by a height/speed/power combination that can

[13] The nautical mile (knot or kt) is a unit of speed equal to 1.852 km per hour or 151 mph.

be worked out using performance graphs from the aircraft's Flight Manual or pilot interpretation.

Landing Profiles.

7.7 It is generally accepted that into wind headings are selected for the final stages of flight when a helicopter is ‘committed’ to land at a site. The committed point is a height/speed/power combination that offers the pilot an opportunity assess his options in the event of critical power loss such as an engine failure. The flight path leading up to that committed point does not necessarily need to be directly into wind allowing the pilot a degree of directional flight path flexibility before committing to land at the desired point. Advanced flying techniques may even commence in a downwind position and finish at the committed point with a steeper turn[14].

Engine Failure.

7.8 The DoD’s point stating that the advent of an engine failure will have an effect on flight profile is accepted. If the pilot elects to continue the flight OEI, then consideration must be given to the shallower climb/descent gradients which are achievable. If an engine failure occurs during take-off a shallower departure would be necessary based on the power available. In any event, once a height/speed/power condition is achieved, the aircraft can manoeuvre laterally as required, hence flight paths can be altered accordingly.

7.9 A pilot may not consider the landing sites the Naval Base suitable for an approach in the event of an engine failure whilst airborne as a running landing may be required. The distance required for a single engine running landing is dependent on the aircraft weight and performance at the touchdown point. The pilot, in this case, may elect to divert to an airport or site with a longer and more appropriate landing area.

[14] Normally conducted by military pilots where restricted manoeuvrability exists.

7.10 In an assessment provided later in this report (Figure 15), it will be seen that the locations of the HNB landing sites offer at least 995m of available distance in which to conduct a departure while maintaining a civil separation criteria of a 150m/500' avoidance zone established around the stack[15]. It is assessed that, even with the most restrictive wind direction, flight path adjustments and alterations to heading for the benefit of obstacle and hazard clearance are achievable in all performance conditions, including OEI.

[15] The DoD/IAC submission re-iterates that civil rules do not apply to the IAC. However, in the absence of any stated figure that the IAC do have to apply, the civil distances has been applied as the worst case scenario; it would be very surprising if the IAC claimed that their pilots require greater safety margins than even amateur civil pilots.

8. Baseline aviation environment

8.1 For an assessment of the helicopter operations which occur at Haulbowline, as detailed in the latest DoD submission, it was necessary to assess the current aviation environment as a baseline. That assessment included an appraisal of existing tall structures which could have an effect as the dominant obstacle in the area and which could, also, have an effect on helicopter operations from HNB. Apart from the chimney at Whitegate (4km to the east) there are numerous pylons, buildings and turbines in the Ringaskiddy area, all of which would need to be considered within any flight planning to land, depart or to conduct operations at HNB. These are shown in detail in the graphic at Annex C.

8.2 The available imagery does not reveal the exact helicopter landing site within the naval base; there do not appear to be any standard helicopter landing site markings nor are there any details for the landing site within available documentation. From photographs in the public domain of helicopters on the ground at Haulbowline it has, therefore, been assumed that the landing area is either at the centre of the former parade ground (hereafter the Main Square) to the north west of the circular building near the westerly extremity of the island or on the playing fields to the east of the island.

Figure 1 – available helicopter landing sites on Haulbowline

8.3 The following Figure is an aerial image of Haulbowline, from the north and looking south, and showing the general area in which the IAC are concerned that their helicopter operations will be endangered/constrained by the presence of the stack.

Figure 2 – Aerial image of Haulbowline looking south

Main Square – This landing site is on to the west of HNB and with an elevation of 8m AMSL. It measures approximately 80m by 25m, has a tarmac surface and does not slope significantly in any direction. The landing site has buildings (single and multi-storey) immediately adjacent to the east, south and west whilst to the north there is the main flagpole which is held by wire stays. The most likely flight profile/path for any approach to land would be to a relatively high hover and then vertical descent. There are two possible profiles for take-off whilst take-off which would either be by a by a “towering take-off”, whereby the aircraft would climb vertically into the air to about 100ft to ensure clearance on the buildings below before transitioning forward, or by a departure where the pilot faces into wind and obtains a positive rate of climb whilst moving backwards; this affords the opportunity that, should an engine fail in the climb the landing pad (as the most suitable area to land) is in front of the aircraft and the pilot has a potential choice of landing back on the ground or, if after the

Critical Decision Point, he can dive for some forward airspeed, reach single-engine climb speed, and climb away with clearance from the surrounding buildings. (Clearance is not just of the aircraft over the buildings but also includes clearance of the rotor downwash over the roofs of the buildings.) Given the availability of the much clearer sports pitch this is considered to be, very much, the least desirable of the two options to operate helicopters from.

Sports pitch – This landing site is to the east of HNB and measures 115m by 80m and with an elevation of 5m AMSL. It has a grass surface and does not slope significantly in any direction. There is road lighting along the western side of the area, a small fence surrounding the pitch, boat parking to the west and a single building to the south side.

8.4 The DoD statement refers solely to operations from the Main Square; it is considered that it might be useful to provide some clarity on such operations. The Main Square would represent an unusual choice as the primary landing area on the island given the significant constraints that exist there in the form of the buildings, the flagpole and wire stays etc. and given the presence of the much better site on the sports pitch. It is reasonable to assume that the operational sorties listed in the DoD submission would be conducted from the sports pitch; indeed, flight safety would demand it.

8.5 However, whilst the sports pitch might represent the more benign environment from which to operate even that has some significant obstacle considerations.

c) Pylons

8.6 The red line is the line of powerlines which extend from the mainland to Haulbowline and which are supported on pylons, one on the island itself, one on the mainland at the end of the causeway/bridge and one on Rocky Island. Running south, the powerlines then across the bay, route to the top of the high ground before then running to the west along the top of the ridgeline above the proposed stack site and onwards to the west.

Figure 3 – the line of pylons running from HNB

8.7 The pylons are marked as red dots and that on Rocky Island is 43m (141 ft) in height on ground 5m high giving an overall height amsl of 48m (158ft). (All positions are subject to detailed topographical mapping. The powerline continues to the west, or right, of the image.)

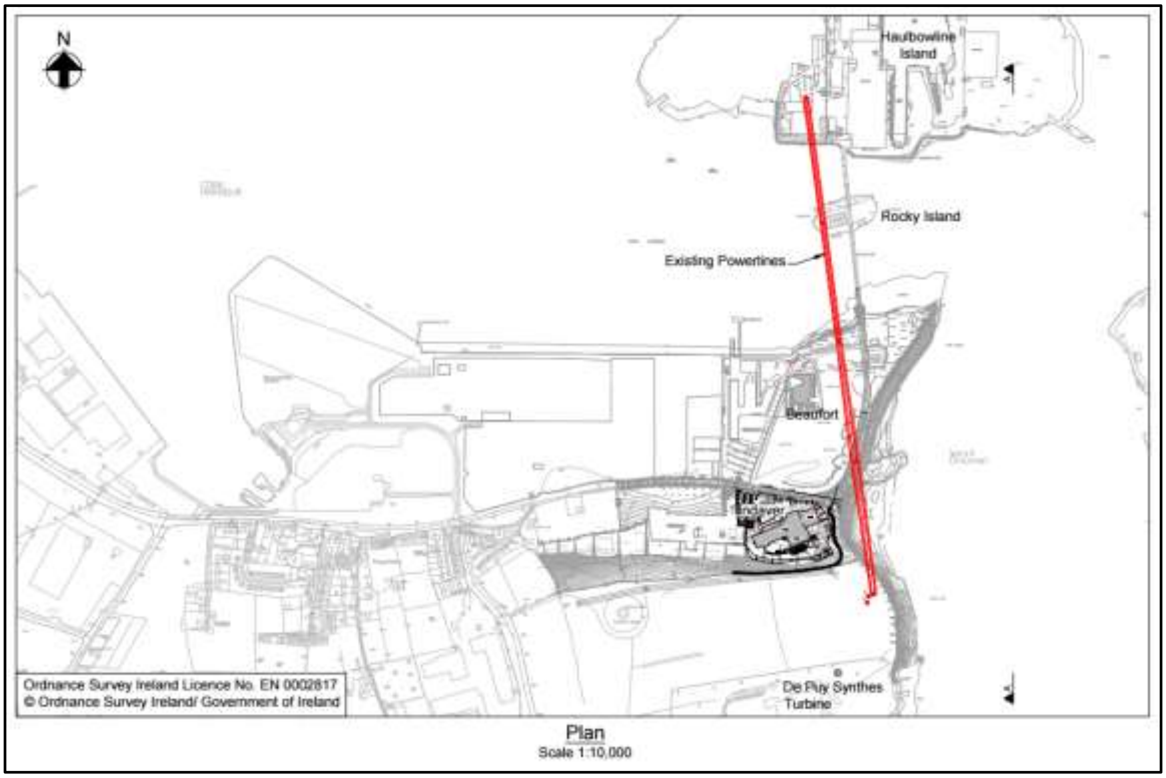

Figure 4 – Ordnance Survey map showing the line of pylons (plan view)

8.8 Power lines are a very significant hazard to aviation, especially at night, as the pylons and cables can be difficult to see against the terrain in the background and are not lit. During take-off and landing, pilots would be expected to remain well clear of power lines, but there is no defined minimum distance during these phases of flight. Military pilots encounter power lines during low-level navigation sorties and are taught procedures to cross pylons in a safe way accordingly. One method of crossing pylons is at 45° to the power line orientation, as opposed to 90°, thus giving the pilot options to land clear of the wires by turning away via a shorter flight path in the event of a forced landing. Another method is to cross over the pylon and that way ensuring that the powerlines are clear below.

8.9 For aircraft operating from the sports pitch this line of pylons and cables represents a wide barrier to flight to the south west until the aircraft is at a safe height above them. There are no cable markers (normally brightly coloured discs or balls) and the pylons do not appear to have any lighting fitted. The difficulty that will exist in seeing the cables, even in daylight and never mind operations at night using

Night Vision Goggles (NVG), will demand that the aircraft is not flown towards this obstruction until that safe height has been achieved. Even the shallow climb which the DoD outline in their submission would still have to be capable of reaching this safe height otherwise the aircraft could not proceed to close on the pylons and cables.

Figure 5 – the climb out from the sports pitch as viewed from ground level on the shoreline of Haulbowline. (Note that as the aircraft lifts to the hover and then proceeds to climb away the perspective of pylons and other obstructions will alter as they "descend" below the skyline making them and the power cables much more difficult to see.)

8.10 In the case of HNB, power lines would need to be accounted for when departing from either landing site on HNB with respect to the prevailing wind speed/direction and the selected take-off or landing profile; the powerlines would be the first, and immediate, potential hazard which the pilot would have to deal with should he elect to fly into such an aviation environment; the aircraft would have to climb above either the cables or pylons.

8.11 When the aircraft is climbed above the cables and pylons the aircraft will be well clear of the stack.

8.12 Conversely, on landing, the aircraft should not be descended below a safe height until clear past the line of cables/pylons and inbound to the HLS.

Figure 6 – the pylon on Rocky Island

Figure 7 – the pylons running east/west along the ridgeline above the Indaver site

8.13 However, the main obstacle and safety consideration in the area and which affects operations from either landing site equally is the presence of the three very large wind turbines the closest of which is 1528m from the centre of the Main Square and 1588m from the centre of the sports pitch. There is also the presence of the National Maritime College.

Figure 8 – other obstacles in the vicinity of Haulbowline

b) The National Maritime College

8.14 Dealing first with the National Maritime College there are no formal avoidance criteria for the National Maritime College published within any aviation document that the authors can source but it would be surprising if there were not local HNB or IAC orders which establish an avoidance criteria as part of noise abatement procedures. Typically, if there are regulations laid down in any local order regarding noise and avoidance, it would be expected that the National Maritime College would have to be avoided laterally by 300 – 500m. In any event, direct overflight of the complex should be avoided.

8.15 Fundamentally, aircraft engaged in load-lifting should not overfly this or any other facility, residential or industrial area.

8.16 The National Maritime College is, at its closet point, approximately 242m from the stack position; if there are local avoidance distances specified within any military orders it would be expected that the Indaver site would be within the "no-fly" zone for the College and could not, therefore, be directly overflown.

8.17 In addition, the ground to the south of the National Maritime College slopes quite significantly from 3m amsl rising to 34m amsl at the ridgeline and within a lateral distance of approximately 270m; a ratio of around 1:9. The slope in the area behind the proposed Indaver site is largely populated by trees, shrubs, gorse etc, the line of which continues west until reaching a residential area; this would further complicate any attempt to land in the event of an emergency for any climb-out heading west or south-west over the proposed facility. To the east the ground slopes down to the shoreline at a distance of approximately 240m and has the added complication of the powerlines. Either option would represent a very undesirable option in the event of a forced landing and flight planning and International Best Practise would suggest the need for a safer option, such as flight over the sea.

Figure 9 – the climb out from the Main Square as viewed from ground level on the shoreline of Haulbowline. (Note that as the aircraft lifts to the hover and then proceeds to climb away the perspective of pylons and other obstructions will alter as they “descend” below the skyline making them and the power cables much more difficult to see; this will not be the case with the turbine).

c) Turbines

8.18 If flying on a heading towards the proposed Indaver site the next major obstacle which any pilot operating from Haulbowline would then encounter would be the very large wind turbine (one of three in the vicinity and with a further two permitted).

8.19 If a pilot were to fly directly overhead the Indaver site then the nearest turbine (Turbine A) would be only 389m further on and on a similar heading (Annex C). As a physical obstruction, if the aircraft is incapable of gaining enough height to remain clear of the Indaver site, then this turbine, as the dominant physical obstruction in the area, will pose a much more significant hazard to the safety of the flight.

8.20 Quite apart from the turbine as a physical obstruction which would need to be avoided, the pilot would have to consider turbulence. Wind turbine wake turbulence, and its influence on light aircraft and microlights, is a complex subject. The turbulence is caused by the wake of the turbine which extends stream wise behind the blades and the tower, from a near to a far field. The dissipation of the wake intensity depends on the convection, the turbulence diffusion and the topology (obstacles, terrain etc.). A turbulent atmosphere is one in which air currents vary over short distances. Currents range from rather mild eddies to strong currents of relatively large dimensions. As an aircraft moves through these currents, it undergoes changing accelerations which jostle it from its smooth flight path. This jostling is turbulence. Turbulence ranges from bumpiness to severe jolts which can structurally damage the aircraft. The main causes of turbulence are convective currents, obstructions to wind flow, wind shear. Turbulence also occurs in the wake of moving aircraft, wake turbulence. Turbulence exists everywhere; it is the severity of the turbulence that is the key factor in aviation.

8.21 The UK Civil Aviation Authority are global leaders in the assessment of wind turbine turbulence and their guidance is contained within CAP 764.[16] Their assessment on the effects of turbine turbulence has been further informed by a commissioned study, conducted on behalf of the CAA, by The University of

[16] Civil Aviation Publican 764 - Policy and Guidelines on Wind Turbines.

Liverpool and the CAA policy has been adopted by airspace Regulators around the world as best practise.[17,18] The UK CAA guidance is that the turbulent effects of wind turbines can be noticeable out to 16 rotor diameters of the turbine in question, behind the turbine.

8.22 It should be noted that the 16D distance would actually be a flight safety factor/consideration for the use of the landing site at HNB as, under certain wind conditions, it lies within the stipulated distance.

8.23 Furthermore, in terms of potential turbulence from turbines the area of most concern for aircraft is immediately behind the rotor where the wind speed has been reduced as the kinetic energy is taken from the air. This is known as the velocity deficit area and extends to 5D.

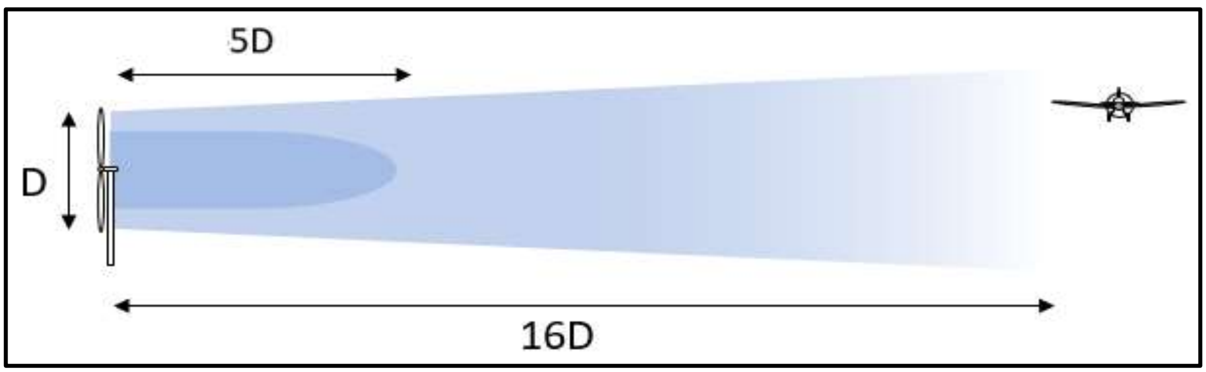

Figure 10 - Side Profile of Turbine Turbulence (Not to Scale – For Illustration Only)

8.24 The US Federal Aviation Authority is the other main source of research and advice on wind turbine turbulence and their position is very closely aligned with the UK CAA and, in some instances, informed by it. FAA sponsored numerical simulations have shown that natural turbulence in the atmosphere will destabilize

---

[17] Wind Turbine Wake Encounter Study, University of Liverpool, March 27 2015.

[18] For example, Airport Cooperative Research Program, Synthesis 28, Investigating safety Impacts of Energy Technologies on Airports and Aviation (Sponsored by the Federal Aviation Authority), 2011, and the Australian Government, Department of Infrastructure and Transport's 123694 dated 17 October 2012. "…*that wind turbines may create turbulence which is noticeable up to 16 rotor diameters from the turbine. This quantitative measurement is based on international research and is consistent with the position of the Civil Aviation Authority of the United Kingdom*"

the wind turbine, creating vortices at a distance out to 6 rotor-radii (250–750 ft) (Troldborg et al. 2007). Within FAA guidance, aircraft flying at the same elevation, or below, as the wind turbine rotor, at a distance where turbulence is projected to occur is determined to be operating in an unsafe location.[19]

8.25 Given the available evidence as to the hazards that can be expected when flying in the vicinity of wind turbines and the available guidance on avoidance margins it is difficult to conceive of any circumstances under which the IAC might consider flying this close to the turbines.

8.26 In Figure 11 the 16D distance is shown by the yellow rings around each of the operating and permitted turbines. The red rings indicate the velocity deficit area, and maximum turbulence area, for each turbine.

Figure 11- turbulence areas behind the operating and permitted wind turbines (depending on wind direction).

[19] Airport Cooperative Research Program, Synthesis 28, Investigating safety Impacts of Energy Technologies on Airports and Aviation (Sponsored by the Federal Aviation Authority), 2011.

Note that the Indaver site is within the velocity deficit area of the nearest turbine and that the two HLS on the island are within the 16D distance in which turbulence can be expected.

8.27 The IAC have stated that they have a requirement to maintain a steady heading until at approximately 1 – 2 km for the departure climb-out and to commence an approach to land from approximately 2km from the landing after site after the recce phase, depending on the wind strength. Based on the IAC stated flight profiles which must be into wind any aircraft taking-off from Haulbowline in southerly/south westerly conditions must expect to experience increasing turbulence during their departure as the flight path is within the yellow circles (and dependent on wind direction) and from the moment they lift from the landing site(s). Similarly, any aircraft landing in a northerly/northwesterly should expect their approach to be subjected to increasing turbulence from two separate turbines for approximately half of their 2km approach.

8.28 With the required 1 – 2 km steady climb out, aircraft will be subjected to that turbulence. Given that the prevailing wind would require flight over populated areas this would present an increasing flight safety hazard, and especially when operating the heavy aircraft and load-lifting profiles outlined in the DoD submission. The worst case scenario is envisaged that an aircraft engaged in load lifting, and flying on either a southerly departure or northerly landing, would experience turbulence which could make the unslung load unstable and to oscillate for which the ultimate solution to save the aircraft is to jettison the load. Furthermore, there is also the remote possibility of an unintended load release.

8.29 There are no IAC procedures for load lifting within the public domain and there does not appear to be anything within IAA documentation. As a comparator the authors have considered some of the guidelines contained within the UK CAA CAP 426[20], UK DAP 101A-1105-1B (Air Transport Operations Manual – Carriage of

[20] CAP 426 – Helicopter External Load Operations

Cargo by Helicopters Underslung Load Clearances) and International Civil Aviation Organisation publications on the Carriage of Dangerous Goods by Helicopter for generic safety considerations, together with their military experience. (There are numerous other nations' guidance on helicopter underslung load operations within the public domain but CAP 426 provides useful background information on the considerations for load lifting by helicopter and there is read across to military operations.) Section 6.5.1. of that UK CAA document states:

> *"The selection of a route for a flight with an external load must be such that the risk to persons or property from a falling load is minimal."*

8.30 In summarising the existing aviation environment, this is an area heavily populated with existing obstacles and flight safety hazards which can be considered as constraints on the safe conduct of flight or as significant factors in the event of an emergency. The existence of the pylons, the cables, the National Maritime College and other industrial/residential development would suggest that these need to be considered during flight planning and together with the dominant physical obstructions in the area, the turbines. These turbines and their associated turbulence, both individually and cumulatively, all contribute to an area over which flying would assume flight safety risk that could, otherwise, be avoided by different route selection.

8.31 We assume that the DoD would plan flights to avoid these risks in accordance with the requirements of good airmanship and that, in reality, given existing conditions, the DoD are very unlikely to ever plan to overfly the Indaver site.

8.32 In highlighting the:

"……….catastrophic consequences of a helicopter suffering a double engine failure with 15 people on board"[21]

it is suggested that, given the hazardous nature of the terrain and existing development (the College, the pylons, the cables, the turbines and the turbulence) the need for those robust risk controls already exists. In the event of a double engine failure conducting a forced landing would not be straightforward, given the obstacles in the area, to the extent that there would be questions as to whether any such landing would be surviveable. International Best Practise would suggest that the IAC would not plan to fly in this area given this concern.

[21] Department of Defence Submission, Department of Defence Reply to Indaver Reports dated 11 May 2016, final page, "Final Comments and Conclusion".

9. The Proposed Indaver Facility and Stack

9.1 The Proposed Indaver WtE facility and stack are approximately 1175m south of the Main Square and 1350m south of Landing site East.

9.2 The proposed Indaver site is approximately 200m from The National Maritime College (at the closest point).

9.3 The stack height at the WtE facility is 70m agl and 80m amsl.

9.4 The distance from the stack to the nearest turbine is 389m.

9.5 The findings of AWN in their site specific modelling have determined that the effects of any plume would have completely dissipated within 3.5m both laterally and vertically.

9.6 The Indaver site is within the 5D velocity deficit area, the area of maximum turbulence, for the nearest turbine (Turbine A).

9.7 If the extant IAC profiles are as heavily constrained during normal operations and if pilots are so limited in manoeuvrability that they cannot avoid the stack which they consider will be such a hazard then, for that stack to become such an obstacle within their flight path, they will have to fly directly overhead (or at best, in very close proximity to) the National Maritime College, the pylons and over significant industrial sites at very low level and then to continue to fly towards the most turbulent area downstream of the turbine (and on occasion with under-slung loads).

9.8 Regardless of the Regulations to which the IAC fly, avoidance of the existing obstructions should preclude the flight being affected by the stack or the plume; in avoiding the existing hazards the aircraft should always be well clear of the stack site.

9.10 The effects of any plume should not add to, or further complicate, the extant aviation considerations.

9.11 The stack will not further complicate an already hazardous aviation environment in the event of emergency. The greatest flight safety hazards are the presence of the turbines, the turbulence and the pylons. If the height of the stack is considered together with the elevation of the ground at the proposed location, the top of the stack will be approximately 80m amsl as opposed to the pylons on the ridgeline (approximately 85m at the highest point) and the turbines, the closest of which (Turbine A) has a tip height of approximately 173m amsl and which is the dominant physical obstruction.

9.12 The major hazards to the safe operation of the HLS on Haulbowline in the profiles outlined by the DoD already exist; the need for the robust controls is agreed, but not for the Indaver site as such controls should already be in place for the existing aviation environment.

9.13 Given the existing environment International Best Practise would suggest that a flight path over the sea, clear of any permanent obstructions (there may be passing vessels), would be the obvious heading of choice for helicopter departure/landing and regardless of the weight of the aircraft, load-lifting etc.

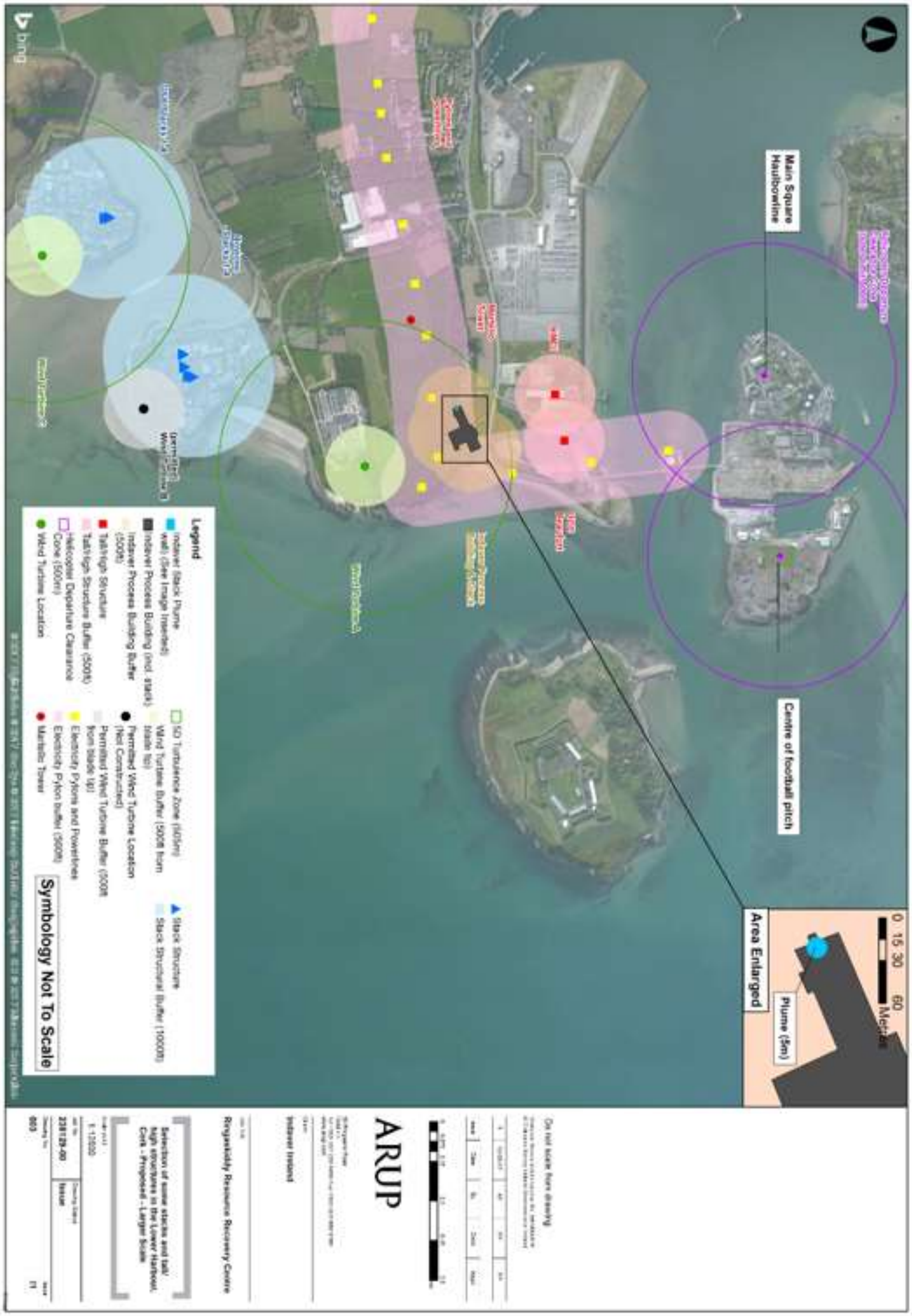

Figure 12 – vertical obstructions in the immediate vicinity of the Indaver site

10. AW 139 Aircraft and Performance

10.1 The AW139 is a medium sized, multi-role helicopter used by the IAC with a troop lifting capacity of 8-14 personnel in the normal configuration. With a Maximum All Up Weight (MAUW) of 6400kg, the helicopter's main roles are Army support, air ambulance, military transport and general utility.

10.2 The DoD/IAC submission provides little, if any, detail as to how the IAC operate the aircraft in terms of performance, but the manufacturers flight manual for the AW139 contains every possible condition to allow for Category A Operations.

10.3 The European Aviation Safety Agency (EASA) definition of Category A is a multi-engined helicopter designed with engine and system isolation features specified in the applicable airworthiness codes and capable of operations using take-off and landing data scheduled under a critical engine failure concept that assures adequate designated surface area and adequate performance capability for continued safe flight or safe rejected take-off in the event of engine failure.

10.4 Category A performance is determined by several operational factors (aircraft weight, wind, temperature, pressure altitude etc) and the departure or arrival profile to be flown. All of this information is represented graphically to determine safe distances and heights to be flown accordingly to clear obstacles, where required. There are clearly defined decision points during take-off and landing (heights and airspeeds) that need to be achieved to satisfy the implicit safety criteria assurances.

10.5 All other operations fall into Category B, which is defined by EASA as meaning a single-engined or multi-engined helicopter that does not meet Category A standards. Category B helicopters have no guaranteed capability to continue safe flight in the event of an engine failure, and unscheduled landing is assumed. In this instance pilot interpretation will determine when an aircraft achieves a 'fly away' or ‘committed’ condition such that in the event of One Engine Inoperative (OEI)[22] the pilot can elect to continue flight or land. As such, OEI before ‘fly away’ and after the ‘committed’ point will require a force landing, even if that means ditching into the sea.

10.6 With reference to the previously mentioned landing site measurements, (being greater than 15m x 15m) an AW139 could conduct Vertical and Helipad type arrival and departure profiles under the Cat A requirement.

10.7 In lieu of any IAC operating profiles, the AW139 manufacturer’s flight manual lends itself as a form performance guarantee. It can be determined that the AW139 has very good Cat A, All Engines Operating (AEO) and OEI performance for the profiles needed to take off and land at the landing sites taking into account the obstacles and hazards in the area. The Rates of Climb (ROC), measured in feet per minute (fpm) graphically represented in Figures 13 and 14 depicts the aircraft at MAUW with in AEO and OEI configurations with the Engine Air Particle Separator (EAPS)[23] switched on. The maximum ROC is 2100 fpm in normal operating conditions which would put the aircraft at or above 500’AGL or AMSL in 15 secs, 1000’ in 30 secs and so on.

[22] This is now the internationally accepted term and abbreviation for what the IAC refer to as “single-engine failure”
[23] Designed to remove dust and sand from engine-bound air in order to prevent damage to key components and prolong engine life, but its use has a power/performance penalty.

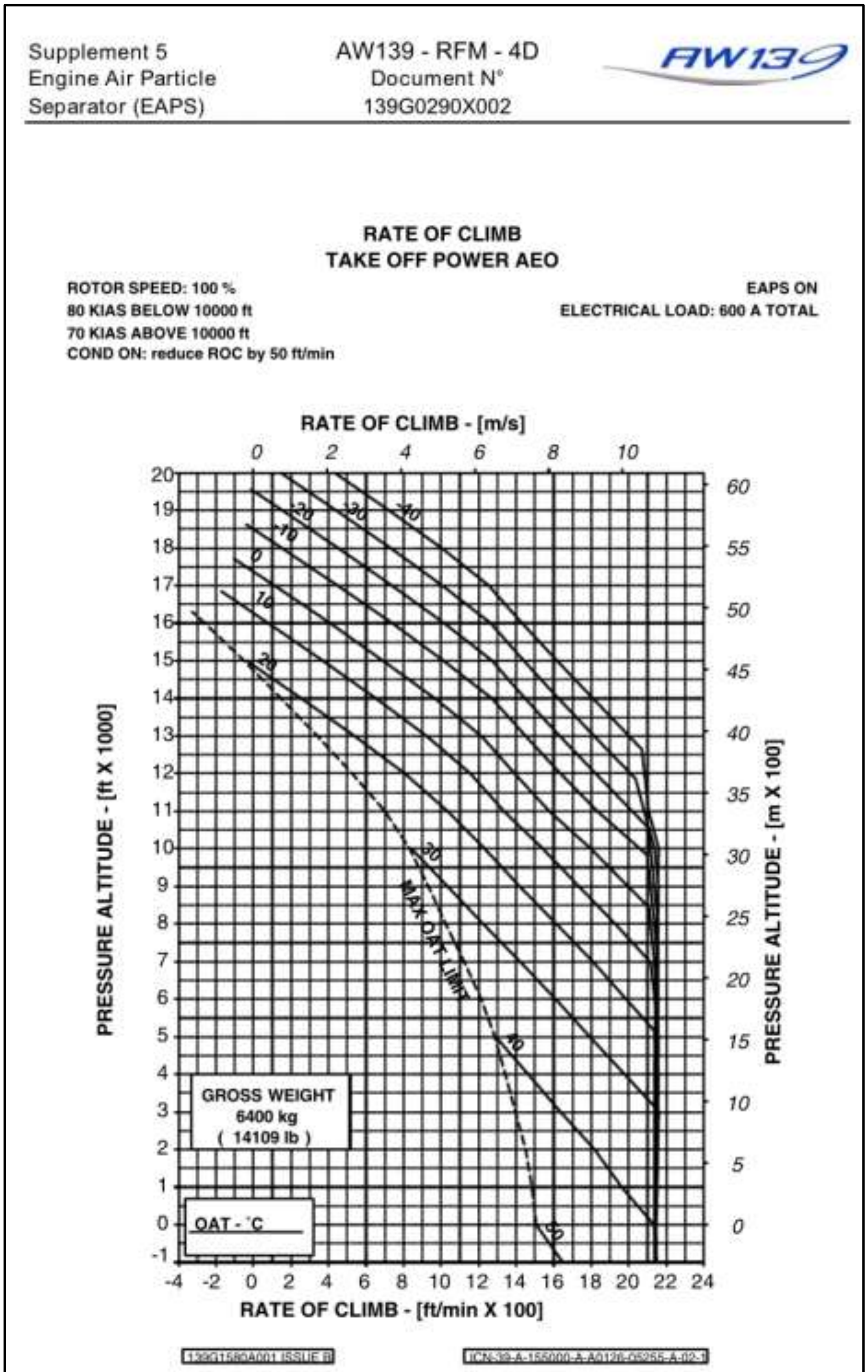

Figure 4-51 ROC TOP AEO Gross Weight 6400 kg EAPS ON

Figure 13 - Rate of Climb Profiles AEO at MAUW 6400kg[24]. Source: Aircraft Manual

[24] It is understood that the IAC AW139 MUAW is 6000kg.

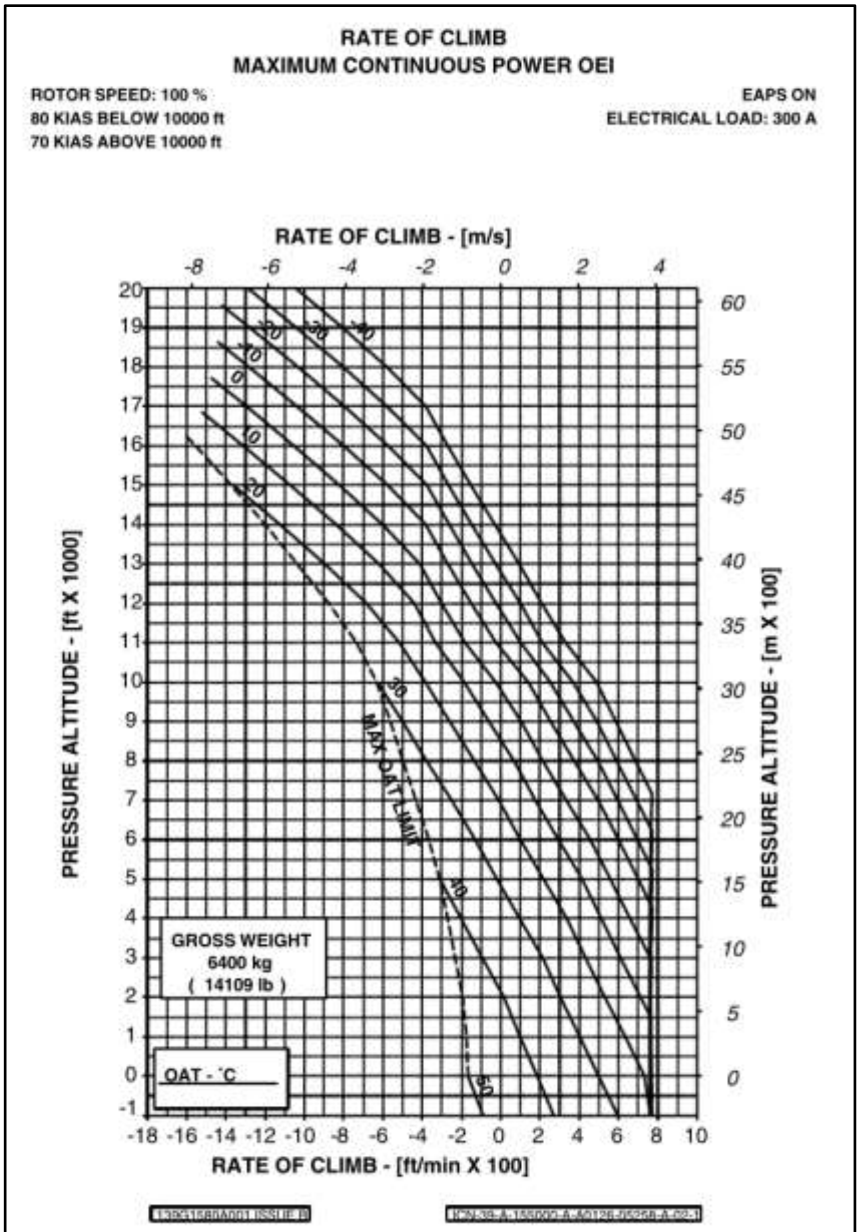

Figure 4-69 ROC MCP OEI Gross Weight 6400 kg EAPS ON

Figure 14 - Rate of Climb Profiles OEI at MAUW 6400kg[25]. Source: Aircraft Manual

10.8 There is a significant disparity between the performance expected from the graphs and the profiles outlined by the DoD. It is accepted that the figures above are based on the manufacturers' understanding of the capability of the

[25] It is understood that the IAC AW139 MUAW is 6000kg

airframe and that the IAC might have placed an additional, internal restriction on that.

10.9 Given the available evidence from AWN's site specific modelling, the exhaust gases from the stack within the plume will dissipate rapidly and well within the avoidance margins IAC pilots should be applying around the existing turbine; the aircraft should be more than capable of climbing above the minimum height/altitude which the avoidance parameters for turbines requires. The stack and plume cannot influence the flight profile/path if internationally accepted guidance is applied.

10.10 If there were to be any constraint on aircraft performance then the safest flight path remains over the sea which, in the opinion of the authors, should be the route of choice for operations from Haulbowline given the existing environment.

11. Haulbowline Navigational and Safety Requirements

11.1 It is accepted that the DoD have researched and explained the requirement to conduct airborne recces as a pre-requisite to a safe and well planned approach to a landing site such as HNB[26]. The methodology explained was indeed correct in part, but the overall point of the recce was missed due to the focus being on extensive circuit procedures.

11.2 An airborne recce is a method employed in aviation to give aircrew[27] an aerial appreciation of landing areas (predominately unfamiliar in nature), associated hazards and best flight paths into and out of landing sites. Flight time spent conducting an airborne recce, including the number of passes required to obtain the information, is based the level of complexity of the landing site. A site may have many flight safety implications that the aircrew may need to consider before conducting an approach, and subsequent departure, that may require several aerial passes to establish best flight paths etc. if the intended landing site is unfamiliar. If the HLS is one that is used frequently, or if the tactical situation demands it, the need for a recce may be significantly abbreviated.

11.3 When conducting a recce, aircrew will consider a number of criteria that will form the development of the approach and departure flight path. A common practice is to use the 5S's to determine whether landing at a site is achievable. From that, flight paths in and out of the HLS can be established based on wind direction, obstacles and hazards. This will be done in addition to confirming any pre-flight planning (on the ground) where a degree of site appreciation would have been carried out on the area of interest. The 5S's are:

- Size
- Shape
- Surface

[26] Department of Defence Reply to Indaver Reports dated 11 May 2016, first page 3rd paragraph.
[27] Crew constitution can involve more than one pilot and/or rear seat crew conducting aerial recces.

- Surroundings
- Slope

11.4 In the case of the Haulbowline landing sites these should be well known or, at least, the information available to IAC pilots.

11.5 Aircrew are not bound by a specific circuit directions or number of approaches and are not restricted to the number of passes required to fully assess a landing site or heights and altitudes to fly. Indeed, it is accepted that complex or unknown sites may require several passes at different heights for a fuller appreciation. Ultimately, aircrew should understand the 3D airspace that surrounds the landing site of interest, and where obstacles, hazards, congested areas and danger areas exist. These factors will determine the aerial recce flight path to be flown.

11.6 The recce and landing profile as described in the DoD submission will cause the aircraft to frequently fly close to, or through, the maximum turbulence zone for at least one of the turbines.

12. Low gradient flight paths - take-off and landing

12.1 Take offs and landings from any site, that are not dictated by any procedural requirement, are largely dictated by pilot appreciation and interpretation based on several aviation factors.

12.2 One of the most important considerations for aircrew is to determine performance margins based on payload. The performance of an aircraft is stipulated in manufacturers operating manuals and will determine flight profiles to be adopted based on power margins available. The payload is generally made up of fuel, passengers and any other stores/baggage. The overall planned take-off or landing weight of the aircraft will normally determine the flight profile to be conducted.

12.3 Flight profiles are designed to provide the safest means of taking off or landing and take into account the overall weight of the aircraft and performance criteria required for that phase of flight. Profiles generally fall into two categories, vertical and clear area arrivals/departures, and are designed to provide a method, in the event of an engine failure, of flight rejection to the ground or flight continuation as conditions and circumstances dictate.

12.4 As discussed previously, a low gradient departure maybe required if an aircraft suffers an engine failure after take-off. Heavier aircraft also perform lower gradient departures and approaches purely based on power margins available and an element of restricted manoeuvrability. In all other cases, and subject to operational reasons, pilots normally adopt profiles that give best performance combinations to achieve safe flight conditions.

12.5 It is recognised that obstacles and hazards have an impact on lower level flight paths. Indeed adherence to published obstacle clearances must be practiced by all aviators, as not do so would be detrimental to flight safety. Where avoidance criteria is not published, flight path considerations and helicopter manoeuvrability (generally termed terrain and obstacle clearance) is the responsibility of the pilot. For the case of hazards such as stacks, turbines, pylons etc prior knowledge of the nature of the industrial site in the pre-flight planning phase would assist the pilot as to the most appropriate flight path to be flown.

12.6 Regardless of the interpretation of the rules and the proximity of flying close to obstacles, good airmanship with regard to the nature and function of the of the hazard should always take priority. Indeed, military pilots 'avoid' all nature of hazards, danger areas, industrial sites, hospitals, as part of their day to day airborne navigational requirements. Just because they are military does not absolve them from basic airmanship. In this case the avoidance criteria has to be based on the turbines and associated turbulence.

12.7 However, for clarity, in assessing the stack as an isolated obstruction, Figure 15 depicts the direct distances from both landing sites on Haulbowline to the 500' periphery of the avoidance zone that would be plotted if the stack were the dominant obstacle in the flight path. The plotted direct track distances to the periphery of the 150m/500' avoidance zone from sports pitch is 1200m and from the Main Square, 995m.

Figure 15 - Distances to the stack avoidance zone from the HNB landing sites

12.8 Based on this information, the take-off distances required for the AW139 to achieve a “fly away” condition fall comfortably within the take-off distance available. As explained previously, there is a degree of flexibility with a take-off direction and even more manoeuvrability after fly away has been achieved, regardless of aircraft weight.

12.9 The proposed stack will not impinge on safe navigation of helicopters in the area given the existing constraints.

a) Take-off

12.10 In Figure 15, distances to the 150m/500ft avoidance zone (in blue) have been plotted accordingly. The plotted direct track distances to the periphery of the 150m/500’ zone from the sports pitch is 1200m and from the Main Square, 995m.

12.11 The distances plotted exceed that required for normal take off criteria where a ‘fly away’ condition exists. Further to the distance available for departure, it is assessed that an aircraft heading adjustment of 10-15° **(**which should be easily achieveable) away from the avoidance zone would provide an obstacle clearance in any event.

b) Landing

12.12 There are no published Instrument Flight Rules (IFR) procedures for HNB. The site should only be approached under Visual Flight Rules (VFR).

12.13 Adopting the 5S principle as part of a site study, pre-flight routine planning g demonstrates that the landing sites present low risk in terms of an aerial assessment. This does not preclude a requirement to perform a recce to establish the wind direction and a visual appreciation of the landing site in question that presents no-fly circumstance.

12.14 Helicopters intending to use HNB landing sites could adopt approaches that conform, where possible and if appropriate, to a series of waypoints, gate positions and/or routing where applicable. Examples of these procedures exist on airport VFR charts and respect obstacle clearance and noise abatement requirements.

12.15 For example, Figure 16 depicts a method of joining and departing HNB with respect to the proximity of the stack at the waste to energy facility. Pilots would have freedom to manoeuvre, for any approach or departure, to and from any gate position via the appropriate routing.

12.16 To ensure a level of separation from the Stack, especially at night, physical visual references should be also used to delineate safe routing, e.g. the shoreline to the east of the stack (Point East).

Figure 16 – possible join/departure procedure for HNB

12.17 Pilots requiring to fly an initial direct track (as depicted) from either landing site to the stack in order to maximize pure headwind components, where power margins are narrow and performance is required (heavy all-up weights or under-slinging cargo), should assess height/speed/power profiles for distance calculations and 'fly away' points to ensure the avoidance zone is not encroached.

12.18 It can be seen that, even if the stack were the only obstacle in the area and that there were no other constraints and an avoidance margin of 150m/500ft were applied on the stack, then normal helicopter operations could still continue to Haulbowline. However, when the avoidance margins for the other more significant obstacles in the area are factored in as the main influence/considerations in helicopter operations to HNB, then the avoidance margins for those obstacles ensure even greater separation on the proposed stack and small plume.

12.19 Interestingly, the DoD submissions stress that the IAC are, first, not bound by the civil avoidance criteria and, second, that they would be required to apply that 150m/500ft on the plume height. As apparent IAC policy to apply a safety risk mitigation it would have been expected that the IAC would then be required to add

500ft to the internationally accepted guidance on wind turbines and turbulence to ensure safe separation from the known high-risk zone of the turbine[28]. This would entail their aircraft flying at 1157ft if within 16D of the turbines and well above the stack and associated plume. This height is higher than the separation distance, plus IAC required additional safety margin, they have calculated for the stack (1075ft above ground level)[29].

[28] Department of Defence Reply to Indaver Reports dated 11 May 2016, paragraph 17.
[29] Department of Defence Reply to Indaver Reports dated 11 May 2016, paragraph 17.

13. RFI - Further comments on the Department of Defence Submission May 2016

13.1 Many of the issues raised by the DoD within their most recent submission will have been addressed within this report thus far. However, for completeness and in accordance with the requirements of the RFI, this section will consider any further outstanding ~~aviation~~ issues.

13.2 In considering the DoD comments on the ARUP report:

- We disagree that the other obstacles in the area can be regarded as not causing any issue within aviation operations.
- Additionally, the statement that all the other obstacles are relatively low level can not be regarded as correct and is not validated by the available evidence. The turbines are listed by the Irish Aviation Authority as an Air Navigation Obstacle.[30]
- In referring solely to the other stacks in the area, and the difficulty which the DoD perceive in determining the extent of the plume due to lack of visibility, the DoD report does not address how the IAC pilots could hope to determine the position/extent of the turbine turbulence which is, apparently, not considered to be an issue.

13.3 In considering the DoD comments on the WFAC report:

- No pilot should deliberately endanger his aircraft and we would, once again, direct the DoD to the final line in the IAA AIC on the Dublin incident which the DoD include as justification for their objection to the proposed stack and which states:

"*Encounters with such gas plumes should not occur where the aircraft is otherwise in compliance with the Rule of the Air in relation to vertical and horizontal separation from structures.*"

[30] IAA IAIP ENR 5.4.

- Furthermore, WFAC pointed out in their submission the FAA advice[31] (which is not in accordance with DoD understanding) and which states:

  "….the safety risk analysis team performed their analysis of the predictive risks associated with the plumes and determined the effects of the hazards as low, or in the green sector of the risk matrix. As a result of this assessment the risk associated with plumes is acceptable without restriction, limitation, or further mitigation."

- The DoD submission refers to V_{BLSS} but the authors of this report consider that the term, and the use of it, needs further explanation. V_{BLSS} is an aircraft velocity (V) attached to a condition, in this case Balked Landing Safety Speed (BLSS). A V_{BLSS} of 40kts is not a hover; in terms of Performance Class 1 (normally a civilian performance requirement but quoted within the DoD submission), it is a speed at which a Balked Landing (a go round or overshoot) can be conducted.

  The speed in this case will enable the aircraft to climb away with a safety margin to achieve a climb gradient, which is not '*akin to a hover*'[32]. Any approach made to a landing site at the Naval Base would require reducing speed to a hovering condition (0kts), but this would be just above the ground (approx. 10' AGL) at the site and not in the vicinity of the of the stack.

13.4 In considering the DoD general comments within their submission:

- The DoD has detailed a historical wind direction in their response based on 10 years of collected data by Met Eireann. A mean wind of 217 ° at Roches Point has been referenced as a specific wind direction for 'most of the time'.[33] The

[31] http://www.ctcombustion.com/oxc/sources/20-safetyriskanalysis.pdf. Federal Aviation Authority Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes, January 2006.
[32] Department of Defence Reply to Indaver Reports dated 11 May 2016, paragraph 16.
[33] Department of Defence Reply to Indaver Reports dated 11 May 2016, second page, third paragraph (not numbered)

mean direction in this case does not reflect the variations of wind patterns over a period of time.

The World Meteorological Organization recommends that climate averages are computed over a 30 year period of consecutive records. The period of 30 years is considered long enough to smooth out year-to-year variations. Met Eireann Aviation Services have catalogued historical weather for Ireland over many more years and have readily available reference data for day-to-day weather and climate comparisons for the area of interest.

The Wind Rose for Cork Airport (EICK) is represented in Figure 17 is for a period of 52 years (1962-2014). It demonstrates the average wind speed and direction over that period as a pictorial representation.

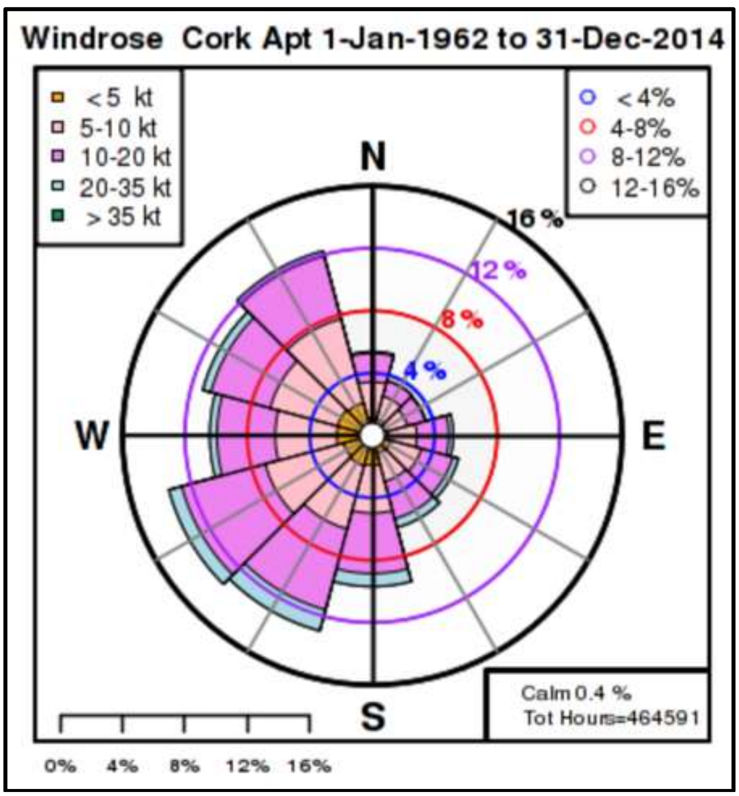

Figure 17 – Wind Rose - Cork Airport 1962 - 2014

More detailed information on winds from 2010 to 2014 are presented in the AWN wind rose at Figure 18.

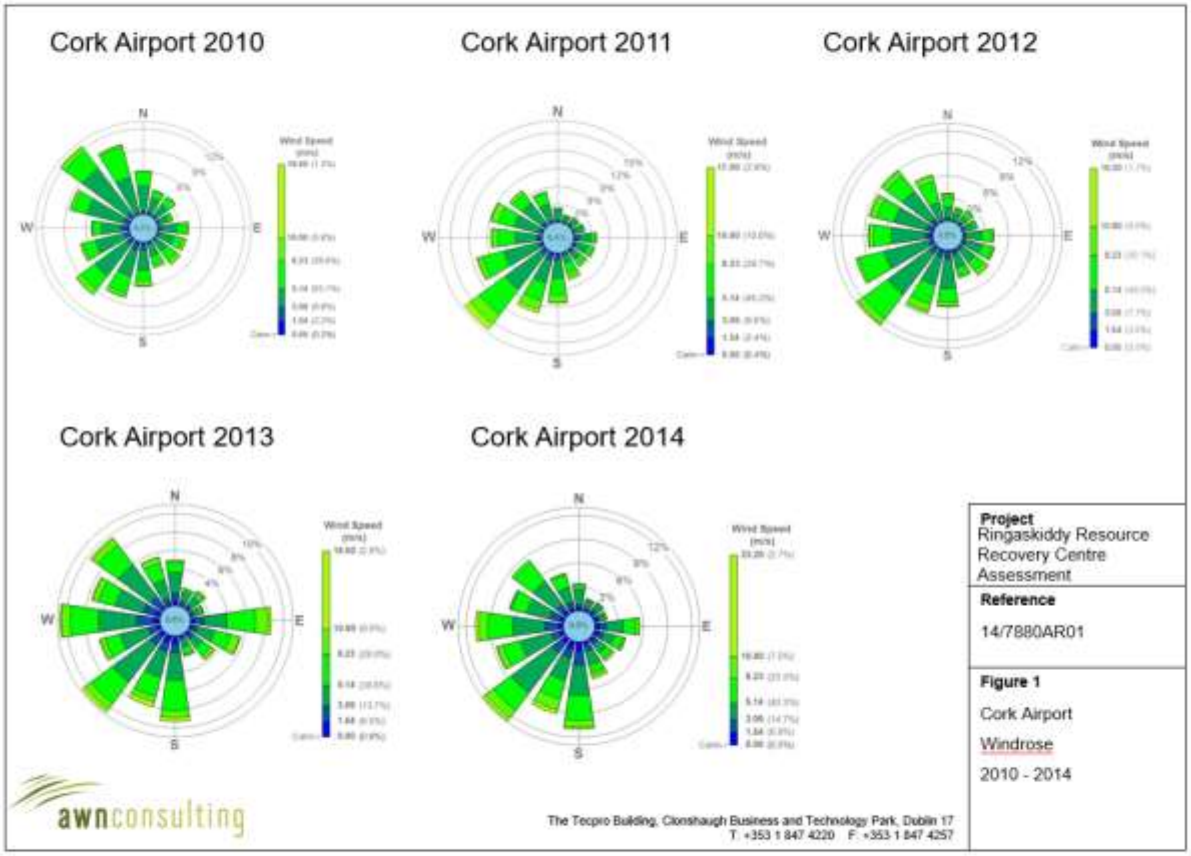

Figure 18 – Wind Rose - Cork Airport 2008 – 2014

The data clearly shows that wind speed and direction has varied considerably over that period and, as such, cannot be defined as a single mean direction for the benefit of wind pattern appreciation in the Cork region.

In general terms the typical wind pattern in the Cork region is predominantly from the South West, but wind speed and direction vary with the seasons throughout the year. In any event, the plume is so small as to not affect, in any way, the approaches to land or departures from Haulbowline even when heading 217 degrees; the plume would parallel the flight profile for the small extent of its existence and would directed away from the direction of Haulbowline with a wind of 217 degrees.

During pre-flight planning, pilots will have access to actual and forecast daily wind data, based on reports issued by meteorological centres. Interpretation of wind speed and direction not only lends itself to the conduct of flight (take off and landings) at the area of interest, but can also be applied to the emissions of pollutants from industrial hazards in that area to aid navigation.

14. Exclusion Zone

14.1 In their initial submission the DoD have stated that the proposed WtE facility could force the DoD to impost a local no-fly restriction around the site with an additional restriction on operations to Haulbowline.[34]

14.2 This report has demonstrated that, if the Indaver stack was the only obstacle in the area, operations could continue to the HLS at Haulbowline; the effects as envisaged by the DoD are not agreed. Furthermore, it is considered that the DoD would not have the authority to "impose" any such zone within the controlled airspace of a major civil airport and without the due procedure and agreement of the airport operating authority and the IAA, as the airspace Regulator.

14.3 The Board have used the term "exclusion zone" and this report will consider both that and "no fly zone".

14.4 The term "Exclusion Zone" should be considered purely military in nature and is one that is more normally associated with warfare between States and the implementation of warning zones or missile engagement areas. The US Doctrinal definition of the term is, generally, "a zone established by a sanctioning body to prohibit specific activities in a specific geographic area. The purpose may be to persuade nations or groups to modify their behavior to meet the desires of the sanctioning body or face continued imposition of sanctions, or use or threat of force."[35]

14.5 A more meaningful term within a civil/military airspace classification would be synonymous with Prohibited, Restricted or Danger Area airspace. Alternatively,

[34] Department of Defence Submission dated 22 April 2016
[35] US Joint Publication 02.

the IAC adopt the term “Military Operating Area (MOA)” to define airspace reserved for military activity which is what is assumed the DoD statement is pertaining to.

14.6 IAA SI No 806 - Irish Aviation Authority (Designated Areas) Order, 2007, provides details of the airspace reservations which can be used in Ireland and which the IAA, as the airspace Regulator have approved. The following are extant:

- Prohibited Area: An airspace of defined dimensions, above land areas or territorial waters of a state, within which the flight of aircraft is prohibited.
- Danger Area: An airspace of defined dimensions within which activities dangerous to the flight of aircraft may exist at specified times. These are military firing ranges.
- Military Operational Area (MOA): means a restricted area for use by aircraft of the Defence Forces within which the flight of civil aircraft may be restricted in accordance with such standing criteria as are specified by the Authority in relation thereto and published in the Aeronautical Information publication.
- Restricted Area: means airspace of defined dimensions in a designated area above the land areas or territorial waters of the state, within which the flight of civil aircraft is subject to specified restrictions.
- Temporary Restricted Areas: are short term restricted areas placed around specific sites, incidents etc.

14.7 There is currently no published[36] civilian or military exclusion/restricted zone specifically around the naval base in Cork Harbour (such as that at Bundoran (1nautical mile, up to 1000ft amsl)). It can be presumed, therefore, that the DoD do not consider that one is necessary given the nature of operations that are conducted there.

[36] Based on the Integrated Aeronautical Information Publication (IAIP) issued by IAA.

14.8 Our findings are that an aircraft being flown under the principles of professional training, good airmanship and military/civil regulation will not have that sortie further complicated by the presence of the stack; the flight profiles should not alter from those currently in place to account for the major hazards in the area and, therefore, any risk to other airspace users from DoD operations will not increase from the current status quo. The case for any possible emergent necessity for an airspace restriction, of whatever nature and based on the Indaver stack, is not, therefore, agreed. Internationally there are numerous helicopter landing sites with stacks much closer than that which is proposed at Indaver and where operations continue without restriction; the singular, unique need for such an airspace measure at Haulbowline is neither justified by the DoD explanation nor commensurate with International Best Practise.

14.9 In any event, the Haulbowline sites lie within the controlled airspace surrounding Cork Airport. Such airspace is called the Control Zone (CTR) and is a volume of controlled airspace surrounding an airport and extending from ground level up to a specified height designed to protect aircraft from other aviation activities during the critical stages of take-off and landing. The Control Area (CTA) is another volume of controlled airspace in which aircraft, after take-off or before landing, can manoeuvre without having to consider other, unknown aircraft.

14.10 These volumes of controlled airspace are “known traffic” environments and all aircraft within these areas must be in receipt of an ATC service from the authority which controls the airspace and have permission to enter that airspace, in this instance from Cork Airport. Haulbowline is, in effect, already within an “exclusion zone”.

15. Additional procedures

15.1 It is difficult to reconcile the need for such a protracted and involved recce procedure which the IAC implement against one of their own military landing sites which, it is understood, is used frequently, against the profiles which they might adopt in the Maritime Counter Terrorism duties they undertake against ships and oil/gas rigs and which will, by necessity, demand an element of surprise.

15.2 This report will consider, as illustrative, the civil guidelines which may be adopted when operating to oil and gas rigs and use the authors' experience to consider operations to ships in order to attempt to understand the IAC stance towards the proposed stack.

a) Oil and Gas Rigs

15.3 The DoD/IAC submission highlights the nature of some flights oil and gas rigs in the Maritime Counter Terrorism (MCT) role. Exact mission profiles for such sorties will be classified but it can be expected that such sorties are planned against known details of the rig in question and an approach to the landing platform is flown direct and without a need for a recce due to the requirement for an element of surprise. Within that planning, and within training for such missions, the IAC must take account of the lit flare stacks which exist on most, if not all, rigs.

15.4 There are no IAA Regulations in the public domain and these would not be relevant to the IAC on such missions. However, there are numerous nations civil aviation guidelines available on the internet and which highlight the procedures to be flown to ensure safe operation of helicopters in the proximity to stacks and to very constrained landing areas on oil and gas rigs; clearly the IAC can operate in such circumstances.

b) Ship/helicopter operations

15.5 The difficulties experienced by the Navy and the IAC in maintaining a naval aviation capability are well documented in the public domain. LE Eithne, as the only ship within the naval flotilla with a flight deck, was designed to operate the Dauphin previously in service with the IAC and there would significant difficulties in trying to operate the AW139 at sea.

15.6 In order to ensure that safe and practical helicopter operations can be conducted from any vessel, the ship's flight deck (or helideck), crew and aviation facilities must meet a range of certification standards, national guidelines, and operator requirements. Additionally, the aircrew must be current in such operations and extensive training is an ongoing requirement.

15.7 Given the potential for extreme conditions, when coupled with combined effects of ship motion, turbulence, and visual cues, such operations can be both demanding and potentially hazardous; the attainment and maintenance of an effective maritime aviation capability is not a simple matter of flying a helicopter on to a ship. There are a wide range of practical factors that contribute to this capability, and a number of technical considerations that must be thoroughly investigated prior to going to sea.

15.8 A major focus of the ship-helicopter integration effort is centred on the conduct of First of Class Flight Trials (FOCFT), which are also referred to as Ship Helicopter Operating Limit (SHOL) trials. SHOL are a group of defined operating limits for safe operation of a particular helicopter type with a given class of vessel. The limits are a function of the vessel's motion and superstructure turbulence characteristics, and also the performance and configuration of the helicopter type. SHOL development involves operating the helicopter in a wide range of environmental conditions, commencing in benign conditions and with an incremental build-up in both weather conditions and helicopter weight. The trials determine the operational flight envelope and any unique procedures required to safely operate from the vessel.

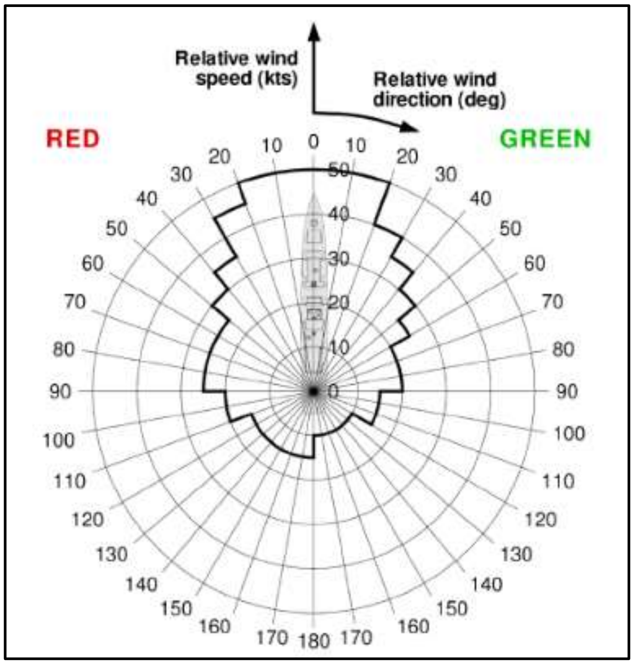

Figure 19 – a generic/typical SHOL

15.9 Whilst there is much information and photographic evidence to highlight the operation of the previous Dauphin helicopters from the LE Eithne, the authors could find no such documentation to support the theory that the ship and the Navy routinely conduct aviation from the ship.

15.10 Any training/operation with the Navy can, therefore, be assumed to be by either winching personnel or load-lifting[37] to the deck (in common with procedures to the other non-flight deck equipped vessels of the Navy). To do so requires the aircraft positioning itself over the flight deck (or suitable clear area of the deck) and matching the ship's speed; the aircraft is effectively hovering over the ship and with the wind, ideally, from the front of the ship. Two publicly available photographs of the Defence Forces operating helicopters with ships web-site are reproduced at Figures 20 and 21.

[37] The DoD/IAC submission refers to replenishing ships (page 2).


Figure 20 - helicopter operating with the LE Ciara


Figure 21 - helicopter approach to the LE Eithne

15.11 Such flight, hovering over the stern of the ship, will place the aircraft, which will often be very heavy, in very close proximity to the funnels of the vessel and within the exhaust gases and where oxygen depletion can be expected to be significant.

15.12 These are the very conditions which the DoD/IAC submission would claim will have such an effect on their operations from Haulbowline as a result of the plume from the proposed stack.

16. Conclusions

16.1 The proposed stack and the resulting small will not preclude or affect operations to either of the landing sites on Haulbowline.

16.2 Even if the proposed stack were the only obstacle in the area, operations to HNB could continue.

16.3 There are other significant constraints to safe flying operations from HNB, the presence of which cannot be discounted and which must have been mitigated and which would then, also, account for any possible effect from the proposed stack.

16.4 In determining the extent of any effects from the proposed stack on aviation, it is necessary to consider the environment in which the stack will be located, in its entirety, and which is heavily populated with obstacles which represent constraints on safe flight operations in the area.

16.5 The most dominant obstacles in the area are the 150m turbine to the south and the resulting turbulence downwind of that turbine. There are an additional two turbines of the same size in the area and with a further two permitted.

16.6 There are major powerlines crossing the area in which the Indaver facility will be located and which would be expected to influence flight profiles on approach and landing.

16.7 It is assumed that there would be some form of avoidance area around The National Maritime College. In adhering to that avoidance criteria IAC aircraft should be routing clear of the area of the stack.

16.8 All of the flight profiles described by the IAC (recce, approach, landing, load-lifting etc) should already be subject to constraints and the required avoidance margin on the turbine should ensure that the stack cannot have any additional impact on IAC operations. The IAC should not be operating in the airspace above the proposed stack at altitudes where the stack or the small plume can affect the flight.

16.9 The DoD operate against unlit pylons and cables. The stack will be lit in accordance with DoD requirements and which will aid conspicuity at night and/or during NVG operations.

16.10 Given the significant hazards and constraints which exist in the area it is not clear why the DoD should routinely look to fly through this airspace and especially on training sorties when there are other, safer routes available. Even if there were demanding operational circumstances, the balance between the necessity to fly in hazardous airspace against fundamental flight safety requirements would point towards the safest option i.e. over the sea.

17. References

Letter - An Bord Pleanála dated 20 March 2017 re 04.PA0045

DoD Submission dated 11 May 2016.

Department of Defence Submission dated 22nd April 2016.

Integrated Aeronautical Information Publication (IAIP) issued by IAA.

UK Civil Aviation Publican 764 - Policy and Guidelines on Wind Turbines.

Wind Turbine Wake Encounter Study, University of Liverpool, March 27 2015.

Enclosure to The Department of Defence letter, Case Reference PL09.PA0041 dated 4th June 2015.

WFAC Ltd Indaver Ringaskiddy, Department of Defence Objection dated 3 May 2016

Airport Cooperative Research Program, Synthesis 28, Investigating safety Impacts of Energy Technologies on Airports and Aviation (Sponsored by the Federal Aviation Authority), 2011.

UK Civil Aviation Publication 426 – Helicopter External Load Operations.

UK DAP 101A-1105-1B (Air Transport Operations Manual – Carriage of Cargo by Helicopters Underslung Load Clearances).

UK Civil Aviation Publication 437 – Standards for offshore helicopter landing areas

AW139 - Aircraft Manual

As the nearest military operator of helicopters and within naval dockyards, for illustration and clarity, two examples of stacks which exist in close proximity to Royal Navy helicopter operations are highlighted below.

1. WESTON MILL LAKE, DEVONPORT.

The nearest naval dockyard to HNB is at Devonport in the UK. Figure 22 is an aerial image of the amphibious ships' docking area in Devonport at Weston Mill Lake with the Commando Helicopter aircraft carrier, HMS Ocean and behind that vessel is the flight deck equipped amphibious assault ship, HMS Bulwark.

HMS Ocean is effectively a floating HLS but with six main landing spots and a further utility landing spot near the bow. Her flight deck is approximately 185m x 16m and covers approximately 2, 960m^{2}. (The HLS on the sports pitch at Haulbowline is, by contrast, much bigger at approximately 115m x 80m or 9,200m^{2}.) The ship is the busiest flight deck in the Royal navy and the normal peacetime complement of aircraft is a mix of 18 attack helicopters and medium lift/heavy lift helicopters.

With the removal of the helicopter landing site on the jetty to facilitate a new landing craft maintenance depot aircraft now have to operate to the ship's decks when there is a need to operate helicopters to the dockyard.

Figure 22 – Weston Mill Lake Devonport.

To the east (right of the image) there is a railway bridge whilst to the north (top) there is civilian housing which cannot be overflown. To the south is the nuclear facility which cannot be overflown and to the north east (top right) is an incinerator with a 95m stack. This is a heavily constrained landing area.

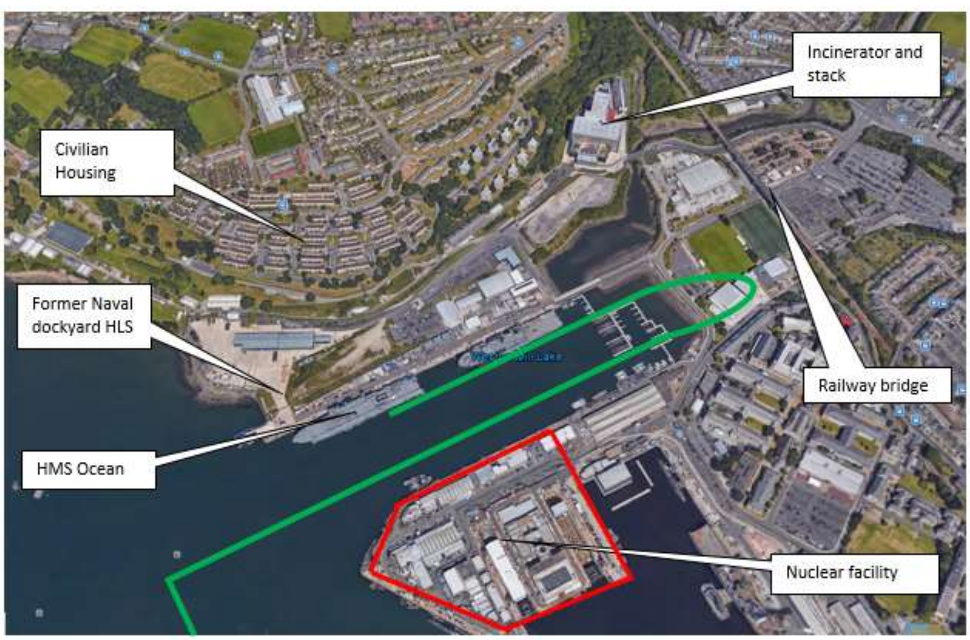

Figure 23 – Weston Mill Lake Devonport.

The Royal Navy continues to operate helicopters to ships alongside the jetty.

A meeting was held in Devonport[38] and was facilitated by the Nuclear Services and Support Office for HMNB Devonport and discussed the operation of the Energy-from-Waste Combined Heat and Power (CHP) facility. The purpose of the visit was to gain an understanding of how the operations of a waste-to-energy facility fitted in with the operations of a busy naval base.

In advance of the development, a study was undertaken to assess the interaction between helicopter operations at Weston Mill Lake and the proposed CHP.

The rules / criteria for helicopter helicopter operations in the Naval Base are set out in the various military documents within the Military Aviation Authority (MAA) Regulatory Document Set and which include the operation of helicopters at domestic landing sites for day operations. Following consultation with the Naval Base Helicopter Operators it was agreed that the proposed CHP plant would place the main building and flue stack clear of the flight path and that the proposals was compliant with MAA criteria.

Personal Statement - Shane Savage

I was the first Lt Cdr (Flying) - the Officer in Charge of flying - in HMS Ocean and was appointed to the ship when she was still in build an about to be commissioned. I have conducted flying onboard through First of Class Flying Trials from the Arctic to the Tropics and throughout the full range of weather conditions in which helicopters can expect to operate in the military context. I conducted the first ever helicopter landing on board the ship alongside in Devonport at the jetty pictured. Having designed the landing spot and airspace procedures flying on board was then developed from the ship in conducting the full spectrum of military operations including Maritime Counter Terrorism, Special Forces insertions, beach assaults,

[38] 27 April 2017

battlefield support, underslung loads, troop drills, military aid to the civil community and from the Caribbean, North Atlantic to the Mediterranean and the Middle East and involving over 18 aircraft embarked.

Prior to this appointment I had previously served in a similar role in RFA Argus in the flying training role and in the amphibious helicopter platform role and when I saw active service in Iraq/Kuwait.

Subsequent to that appointment in HMS Ocean I became the Senior Air Traffic Control Officer at the Plymouth Military Air traffic Control Centre and the Staff Aviation Advisor to Flag Officer Sea Training. Within that appointment I was responsible for all air operations within the dockyard and associated Danger Areas and held the responsibility for managing the contract for the helicopter support unit which operated in the training and support role to the training. As such, I was the operator of the Weston Mill Helicopter Landing site. During this appointment I was also the air advisor to the Nuclear base Safety Committee for the dockyard nuclear facility and was a member of the safeguarding committee for HMNB.

I consider all of this experience to be relevant in my contribution to this report. I am fully aware of the considerations to be made when operating HLS and of what constitutes a valid constraint to safe helicopter operations. My personal opinion is that, based on my experience, I do not agree with the DoD assessment in regards of the degree to which the stack could be considered as a hazard to aviation and I would not have discounted the presence of the significant hazards that do exist in considering the viability of safe helicopter operations from Haulbowline.

Shane Savage

2. ROYAL NAVAL AIR STATION CULDROSE

Royal Naval Air Station Culdrose is one of the busiest military air bases in Europe and is home to the Royal Navy Seaking and Merlin Helicopter fleets as well as Hawk fast jet and Avenger turbo-prop aircraft and frequently hosts helicopters from other Royal Navy Squadrons, RAF and Army Air Corps and NATO navies and airforces.

The base is in Cornwall and experiences very similar weather conditions to Haulbowline.

The base boiler room chimney stack is less than 500m from the threshold of runway 36; helicopter operations continue unaffected by the stack and in all winds/weathers.

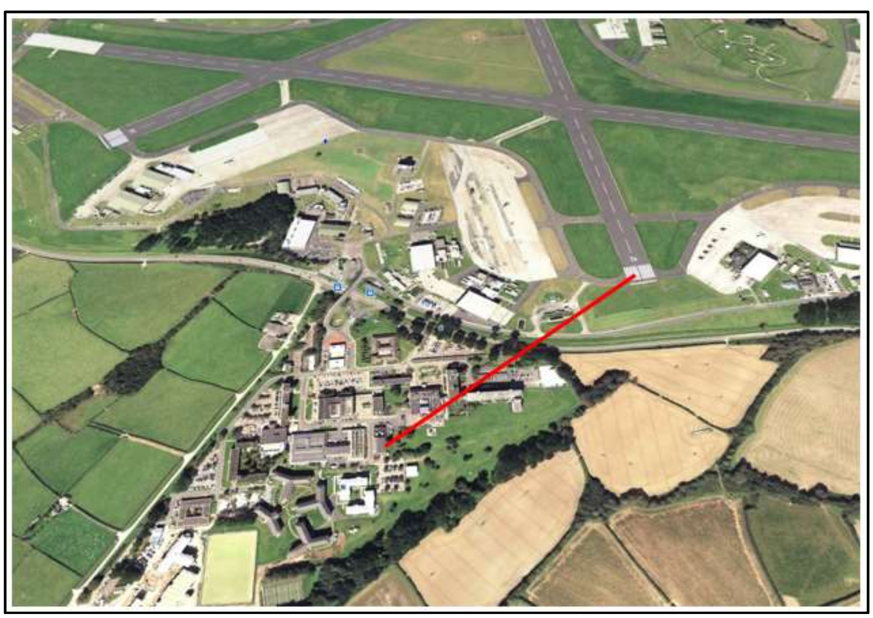

Figure 24 – Royal Naval Air Station Culdrose

Personal Statement - Shane Savage

I am a previous Senior Air Traffic Control Officer at Royal Naval Air Station Culdrose where I was tasked with the safe and efficient air traffic management at one of the busiest airfields in Europe. In delivering that capability I was responsible for the development, maintenance and safeguarding of the Air Station procedures and standards within those and for both fixed (propeller and fast jet) and rotary wing (helicopters).

In spite of the boiler house chimney being in close proximity to the approach and departure lanes for a busy runway and in prevailing south westerly winds, I have never experienced an incident where a pilot considered that the emissions from the chimney influenced or affected the conduct of his flight. Apart from lighting (to assist in night flying) no special measures were put in place for any procedure or flight path as a result of the chimney.

Shane Savage

Annex B to
PL04.PA0045
RFI - Helicopter
Navigation
dated 10 May 2017

Helicopter Landing Sites in Ireland, Northern Ireland, England, Scotland, and Wales

The following information has been derived from sources in the public domain. The Table lists helicopter landing sites within Ireland, Northern Ireland, England, Scotland and Wales which have chimney/ stacks within 1000m of the landing point. No landing site operator has been contacted to determine the accuracy of the published information and all details are subject to detailed topographical survey.

The Table does not include any civil commercial airport, general aviation airport, gliding/parascending or parachuting site, or military airfield, which lists chimney/ stacks in the vicinity.

Where chimney/stacks heights are provided at the information source in feet, these have been converted to metres and rounded to the nearest full metre to facilitate comparison with HNB.

Country	Landing Site Name	Grid Ref	Civil/Military/Hospital Landing Site	Chimney Height (m)	Distance from Landing Site
R.O.I.	Galway, UCH	N53 16·61 W009 04·25	Hospital Landing Site	48	400m north east
R.O.I.	Tralee Hospital	N52 15·87 W009 41·16	Hospital Landing Site	48	400m west
N.I.	Kinnegar	N54 38·14 W005 50·79	Military	13	Immediately adjacent
N.I.	Lisburn	N54 31·32 W006 02·96	Military	48	100m north west
N.I.	Maydown	N55 01·58 W007 15·32	Police	40	100m south
N.I.	Strabane	N54 49·54 W007 27·57	Police	13	Immediately adjacent
N.I.	Craigavon Hospital	N54 26·18 W006 24·73	Hospital Landing Site	48	70m east
N.I.	Newry Hospital	N54 10·85 W006 20·70	Hospital Landing Site	61	300m west
N.I.	Tyrone County Hospital	N54 36·09 W007 16·96	Hospital Landing Site	27	100m north west
N.I.	Larne (proposed)		Civil	126 (times 3)	1000m east

Country	Landing Site Name	Grid Ref	Civil/Military/Hospital Landing Site	Chimney/stack Height (m)	Distance from Landing Site
England	Abingdon	N51 41·25 W001 18·82	Military	24 (times 2)	150 east
England	Ashford	N51 08·57 E000 54·97	Hospital Landing Site	46	60m east
England	Ashington	N55 10·97 W001 32·86	Hospital Landing Site	21	240m north east
England	Barnsley	N53 33·16 W001 30·41	Hospital Landing Site	53	800m north east
England	Barrow in Furness	N54 08·06 W003 12·41	Hospital Landing Site	30	200m north west
England	Basingstoke	N51 16·91 W001 06·82	Hospital Landing Site	91	300m south east
England	Birmingham (Heartlands	N52 28·76 W001 49·98	Hospital Landing Site	30	500m east
England	Birmingham (Selly Oak)	N52 26·10 W001 56·12	Hospital Landing Site	61	925m north west
England	Bolton	N53 33·34 W002 25·53	Hospital Landing Site	55 and 30	400m south west
England	Burton on Trent	N52 48·89 W001 39·26	Hospital Landing Site)	37	200m and 500m north west
England	Chelmsford	N51 43·95 E000 27·62	Civil	24	80m south west
England	Chesterfield	N53 14·07 W001 23·68	Hospital Landing Site	30	300m north
England	Crewe	N53 07·21 W002 28·82	Hospital Landing Site	76	100m south east
England	Donington	N52 43·49 W002 26·57	Military	30	100m north west
England	Grantham	N52 55·25 W000 38·73	Hospital Landing Site	24 (times 2)	250m north east

England	Grimsby	N53 32·57 W000 05·84	Hospital Landing Site	46	550m north east
England	Guildford	N51 14·49 W000 36·37	Hospital Landing Site	46	50m west
England	Harefield	N51 36·45 W000 29·06	Hospital Landing Site	30	90m north east
England	Hastings	N50 53·24 E000 34·06	Hospital Landing Site	37	300m south
England	Haywards Heath	N50 59·27 W000 05·78	Hospital Landing Site	37	300m north east
England	Hull	N53 44·70 W000 21·72	Hospital Landing Site	61	350m east
England	Keighley	N53 54·02 W001 57·99	Hospital Landing Site	24	200m south east
England	Lancaster	N54 02·52 W002 48·05	Hospital Landing Site	43	200m north
England	Leicester	N52 39·23 W001 10·92	Hospital Landing Site	18	250m north west
England	London Heliport	N51 28·20 W000 10·77	Civil	Numerous	Numerous
England	London (King George)	N51 34·58 E000 06·12	Hospital Landing Site	52	500m north east
England	London (King's College)	N51 27·74 W000 05·76	Hospital Landing Site	40 (times 2)	300m north east
England	Margate	N51 22·55 E001 23·29	Hospital Landing Site	61	250m north
England	Milton Keynes	N52 01·53 W000 44·06	Hospital Landing Site	23 (times 2)	220m and 290 north
England	Newcastle	N54 58·82 W001 37·20	Hospital Landing Site	46	100m north west
England	Nuneaton	N52 30·85 W001	Hospital Landing Site	23	350m north east

		28·72			
England	Plymouth (Derriford)	N50 25·11 W004 06·80	Hospital Landing Site	75	160m south
England	Poole	N51 28·55 W002 47·60	Military	61	925m east
England	Portsmouth (Fleetlands)	N50 50·09 W001 09·98	Military/Civil	37	400m south east
England	Preston	N53 47·47 W002 42·53	Hospital Landing Site	30	200m south east
England	Redditch	N52 16·87 W001 54·78	Hospital Landing Site	37	300m south east
England	Redhill	N51 13·25 W000 09·78	Hospital Landing Site	34	170m south east
England	Romford	N51 34·20 E000 10·71	Hospital Landing Site	46	110m south east
England	Salisbury	N51 02·65 W001 47·17	Hospital Landing Site	18	100m west
England	Salisbury	N51 02·65 W001 47·17	Hospital Landing Site	37	200m north west
England	Scarborough	N54 16·94 W000 26·35	Hospital Landing Site	61	300m east
England	Shrewsbury	N52 42·53 W002 47·51	Hospital Landing Site	44	250m west
England	Shrewsbury	N52 42·53 W002 47·51	Hospital Landing Site	44	700m west
England	Slough	N51 32·06 W000 34·53	Hospital Landing Site	30	170m south east
England	Stevenage	N51 53·13 W000 12·39	Civil (Urban)	46 (times 2)	Immediately adjacent north and north east
England	Stockton	N54 34·93 W001 20·76	Hospital Landing Site	49	150m east
England	Stoke on Trent	N53 00·16	Hospital Landing Site	30	925m north east

		W002 12·64			
England	Sunderland	N54 53·73 W001 24·42	Hospital Landing Site	60	900m north
England	Swindon	N51 32·23 W001 43·67	Hospital Landing Site	20	160m south east
England	Truro	N50 16·4 W005 05·67	Hospital Landing Site	18 (times 2)	20m south
England	Truro	N50 16·4 W005 05·67	Hospital Landing Site	30	200m east
England	Tunbridge Wells	N51 08·98 E000 18·46	Hospital Landing Site	23	100m south
England	Wakefield	N53 23·09 W002 34·55	Hospital Landing Site	37	300m north
England	Whitehaven	N54 31·70 W003 33·64	Hospital Landing Site	46	200m north
England	Worcester	N52 11·39 W002 10·66	Hospital Landing Site	24	280m west
England	Worthing	N50 49·08 W000 21·93	Hospital Landing Site	37	200m south
England	Wythenshawe	N53 23·26 W002 17·41	Hospital Landing Site	30	100m west
Scotland	Ayr	N55 25·85 W004 35·89	Hospital Landing Site	23	400m north east
Scotland	Campbeltown	N55 25·18 W005 36·29	Hospital Landing Site	20	150m north east
Scotland	Dumfries	N55 03·32 W003 35·90	Hospital Landing Site	30	250m south east
Scotland	Dundee	N56 27·76 W003 02·51	Hospital Landing Site	37	450m east
Scotland	Edinburgh	N55 57·64 W003	Hospital Landing Site	18	250m west

		13·67			
Scotland	Edinburgh	N55 57·64 W003 13·67	Hospital Landing Site	61	800m west north west
Scotland	Edinburgh	N55 55·48 W003 08·17	Hospital Landing Site	24	100m south east
Scotland	Glasgow	N55 54·28 W004 25·39	Hospital Landing Site	30	250m north west
Scotland	Kilmarnock	N55 36·77 W004 32·70	Hospital Landing Site	55	400m north east
Scotland	Kirkudbright	N55 52·29 W003 24·24	Military	18	200m north east
Scotland	Inverness	N57 28·59 W004 11·67	Hospital Landing Site	24	130m north west
Scotland	Inverness	N57 28·59 W004 11·67	Hospital Landing Site	61	250m south east
Scotland	Livingston	N55 53·50 W003 31·00	Hospital Landing Site	46	250m west
Scotland	Melrose	N55 35·76 W002 44·51	Hospital Landing Site	30	100m south east
Scotland	Stornoway	N58 13·31 W006 22·90	Hospital Landing Site	30	75m south
Scotland	Stranraer	N54 53·95 W005 01·25	Hospital Landing Site	30	200m south west
Wales	Abergavenny	N51 49·55 W003 02·20	Hospital Landing Site	46	500 south east
Wales	Bangor	N53 12·54 W004 09·46	Hospital Landing Site	37	130m north west
Wales	Chester	N53 12·70 W002 53·82	Hospital Landing Site	46	200m north west
Wales	Haverfordwest	N51 48·83 W004 57·85	Hospital Landing Site	61	150m south west

Wales	Merthyr Tydfil	N51 45·81 W003 23·21	Hospital Landing Site	46	150m north east
Wales	Rhyl	N53 16·43 W003 29·88	Hospital Landing Site	30	160m south