

# Appendix 5-8 Lighting and Marking Plan





# ORIEL WIND FARM PROJECT

## Environmental Impact Assessment Report Appendix 5-8: Lighting and Marking Plan

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March 2024

## ORIEL WIND FARM PROJECT – LIGHTING AND MARKING PLAN

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## ORIEL WIND FARM PROJECT – LIGHTING AND MARKING PLAN

### Acronyms

Term	Meaning
AIC	Aeronautical Information Circular
AIS	Automatic Identification System
AMSL	Above Mean Sea Level
ASAM	Aeronautical Services Advisory Memorandum
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CIL	Commissioners of Irish Lights
DCCAIE	Department of Communications, Climate Action and Environment (renamed DECC since 2019)
DoD	Department of Defence
EIAR	Environmental Impact Assessment Report
HAT	Highest Astronomical Tide
IAA	Irish Aviation Authority
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IAIP	Integrated Aeronautical Information Package
ICAO	International Civil Aviation Organization
IRCG	Irish Coast Guard
LAT	Lowest Astronomical Tide
LMP	Lighting and Marking Plan
MCA	Maritime and Coastguard Agency (UK).
HWM	High Water Mark
MSO	Marine Survey Office
OSS	Offshore Substation
OREDPA	Offshore Renewable Energy Development Plan
OREI	Offshore Renewable Energy Installation
SAR	Search and Rescue
SPS	Significant Peripheral Structures
UKHO	United Kingdom Hydrographic Office
WTG	Wind Turbine Generator

### Units

Unit	Description
cd	Candela
fpm	Flashes per Minute
kHz	Kilohertz
kt	Knot (unit of speed equal to nautical mile per hour, approximately 1.15 mph)
m	Metre
nm	Nautical Mile (1 NM = 1,852 m)



## ORIEL WIND FARM PROJECT – LIGHTING AND MARKING PLAN

# 1 INTRODUCTION

## 1.1 Background

The Oriel Wind Farm Project (hereafter referred to as “the Project”) is located in the Irish Sea, off the coast of County Louth (approximately 22 km east of Dundalk town centre and 18 km east of Blackrock). The offshore infrastructure will comprise 25 wind turbine generators (WTGs), inter-array cabling, an Offshore Substation (OSS) and an offshore cable to the landfall south of Dunany Point.

## 1.2 Scope and objectives of the Lighting and Marking Plan

This Lighting and Marking Plan (LMP) covers the following:

- Marine lighting and marking during the construction phase;
- Marine lighting and marking during the operational and maintenance phase;
- Aviation lighting and marking during the construction phase; and
- Aviation lighting and marking during the operational phase.

The overall objective of this LMP is to set out the lighting and marking scheme that will be implemented for the Project. The LMP applies to both the construction phase of the Project, including lighting and marking of temporary or part-built fixed structures and the operational and maintenance phase of the Project, including additional associated buoyage. Consultation in relation to the appropriate lighting and marking of the Project has been undertaken with the Irish Coastguard (IRCG), Marine Survey Office (MSO), Commissioners of Irish Lights (CIL), Irish Aviation Authority (IAA) and Department of Defence (DoD) and this has informed the development of this LMP.

## 1.3 Guidance documents

The guidance documents contained in Table 1-1 have been used in the collation of this LMP.

**Table 1-1: Guidance documents.**

Policy/Guidance	Key provisions
Aeronautical Services Advisory Memorandum (ASAM) No: 018 Issue 2 Guidance Material on Off-Shore Wind Farms.	The purpose of the document is to provide general guidance for lighting, marking and radar enhancement requirements and also on information required for promulgation to ensure the conspicuity of wind farm machines and associated structures, so as to protect air and marine navigation safety.
Civil Aviation Publication (CAP) 437 Standards for Offshore Helicopter Landing Areas (CAA., 2021).	This document provides the criteria applied by the Civil Aviation Authority (CAA) in assessing the standards of offshore helicopter landing areas for worldwide use by helicopters registered in the United Kingdom (UK).
MGN 654 Guidance on “UK Navigational Practice, Safety and Emergency Response Issues”.	This Marine Guidance Notice highlights issues to be considered when assessing the impact on navigational safety and emergency response arising from Offshore Renewable Energy Installations (OREI). Including traffic surveys, consultation, structure layout, collision avoidance, impacts on communications/ radar/ positioning systems and hydrography.
MGN 372 “Guidance to Mariners Operating in the Vicinity of UK OREIs”.	Covering Issues to be considered when planning and undertaking voyages near OREI off the coast.

**ORIEL WIND FARM PROJECT – LIGHTING AND MARKING PLAN**

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**Policy/Guidance**

International Association of Marine Aids to Navigation and Lighthouse Authorities 0-139 the Marking of Man-Made Offshore Structures.

**Key provisions**

Guidance to national authorities on the marking of offshore structures including wind farms.

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## 1.4 Structure of the document

This LMP is structured as follows:

- Section 2: Overview of the Project;
- Section 3: Marine Lighting and Marking; and
- Section 4: Aviation Lighting and Marking.

## 2 OVERVIEW OF THE PROJECT

The Project will consist of 25 WTGs and one OSS installed on monopile foundations and a series of inter-array cables within an offshore wind farm area of 27.7 km<sup>2</sup>. Electricity will be transferred from the OSS to shore through one offshore cable located in the offshore cable corridor between the offshore wind farm area and the landfall south of Dunany Point. The Project parameters are presented in the sections below.

### 2.1 Wind Turbine Generators

The Project will include 25 WTGs with an upper blade tip height of 270 m above Lowest Astronomical Tide (LAT) (see Figure 2-1 and Table 2-1). The lowest point of the rotor sweep for the Project is 27 m above LAT, which is approximately 22 m above High Water Mark (HWM) in this location.

### 2.2 Offshore substation

The Project will include one OSS, 40 m in height above LAT, 40 m in length and 30 m in width.

### 2.3 Foundations

WTG and OSS foundations will comprise monopile foundations with associated scour protection.

### 2.4 Inter-array cables and offshore cable

The project design includes for 41 km of inter-array cables installed within the offshore wind farm area, with a minimum burial depth of 0.5 m, and associated cable protection along a maximum of 50% of the route. There will be one offshore cable of 16 km in length between the OSS and the landfall, with a minimum burial depth of 0.5 m, and associated cable protection along a maximum of 50 % of the route.

The project design allows for cable protection consisting of rock placement or concrete mattresses 10 m in width and 2 m in height above the seabed within the offshore wind farm area (inter-array cables) and along the offshore cable route.

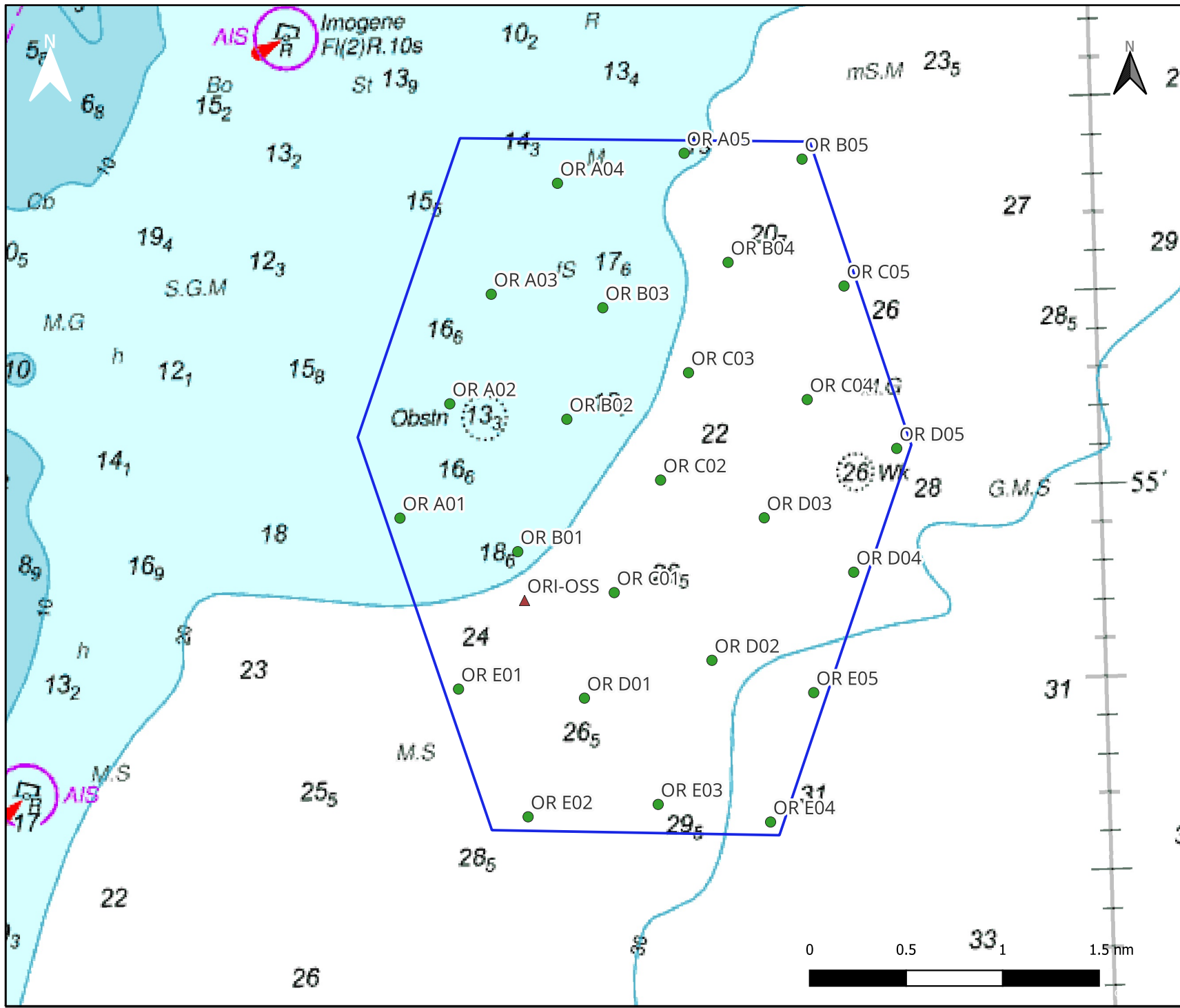
### 2.5 Layout

The Project layout as well as the marking, lighting and fog-horn specifications will be designed and constructed in consultation with the IRCG, IAA, DoD and the CIL.

The Project layout will adhere to the following layout principles:

1. All surface offshore infrastructure will be confined within the offshore wind farm area;
2. A minimum spacing of 4 x maximum rotor diameter (i.e. 944 m) will be maintained between the centre points of all WTGs;
3. The layout will meet the requirements of MGN 654 to facilitate Search and Rescue (SAR) access; and
4. The offshore cable will be located within a defined offshore cable corridor from the southwestern side of the offshore wind farm area to the landfall south of Dunany Point.





**Legend**

- Offshore Wind Farm Area
- Offshore Sub Station
- Wind Turbine

Client

Project **Oriel Windfarm EIAR**

Title **Figure 2-1: Infrastructure Naming**

**Issue Details**

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**Table 2-1: Infrastructure naming and coordinates.**

Coordinate system WTG ID	ITM - CRS: 2157		UTM-29N / CRS: 32629		WGS 84 / CRS: 4326	
	Easting	Northing	Easting	Northing	Longitude	Latitude
OR A1	724655	797868	690292	5977973	-6.10248	53.91517
OR A2	725133	798965	690755	5979076	-6.09476	53.91517
OR A3	725531	800017	691138	5980134	-6.08827	53.93426
OR A4	726167	801082	691759	5981208	-6.07815	53.94367
OR A5	727383	801370	692970	5981513	-6.05952	53.94596
OR B1	725786	797546	691427	5977667	-6.08540	53.91200
OR B2	726257	798817	691881	5978944	-6.07771	53.92330
OR B3	726602	799887	692210	5980019	-6.07202	53.93283
OR B4	727805	800323	693407	5980472	-6.05353	53.93645
OR B5	728515	801314	694103	5981473	-6.04231	53.94517
OR C1	726712	797153	692359	5977287	-6.07148	53.90825
OR C2	727157	798233	692789	5978373	-6.06426	53.91784
OR C3	727425	799264	693042	5979408	-6.05976	53.92703
OR C4	728565	799006	694186	5979166	-6.04252	53.92443
OR C5	728918	800096	694523	5980261	-6.03669	53.93413
OR D1	726426	796140	692087	5976270	-6.07625	53.89922
OR D2	727650	796503	693306	5976650	-6.05748	53.90218
OR D3	728152	797871	693789	5978025	-6.04928	53.91434
OR D4	729011	797349	694655	5977515	-6.03643	53.90944
OR D5	729424	798537	695051	5978709	-6.02965	53.92001
OR E1	725217	796227	690877	5976340	-6.09460	53.90029
OR E2	725885	795001	691562	5975123	-6.08494	53.88912
OR E3	727134	795120	692810	5975260	-6.06591	53.88989
OR E4	728213	794951	693891	5975106	-6.04957	53.88810
OR E5	728627	796193	694287	5976354	-6.04276	53.89915
ORI-OSS	725851	797078	691500	5977200	-6.08496	53.90778

## 3 MARINE LIGHTING AND MARKING

This section sets out how the Project will be marked and lit to meet the requirements for marine lighting and marking. The draft marine lighting and marking scheme was circulated with the CIL, MSO and IRCG for comment and in order to obtain an agreement in principle on the Project's marine lighting and marking. The marine lighting and marking scheme has been designed to be in compliance with the relevant guidance presented in section 1.3.

### 3.1 Promulgation of information

Details of the Project will be promulgated to relevant marine stakeholders in advance of, and during, construction, and also during the operational and maintenance phase where appropriate. Stakeholders will also be informed when construction is complete. The relevant marine stakeholders to be informed include but are not limited to:

- CIL;
- IRCG;
- MSO;
- United Kingdom Hydrographic Office (UKHO);
- Local fishing organisations;
- Local marine organisations;
- Irish Sailing;
- Kingfisher Bulletin; and
- Belfast Maritime and Coastguard Agency (MCA) marine office.

### 3.2 Statutory sanction

As required by the CIL, the Project will submit an application for statutory sanction to the CIL prior to the implementation, alteration, or removal of any aid to navigation.

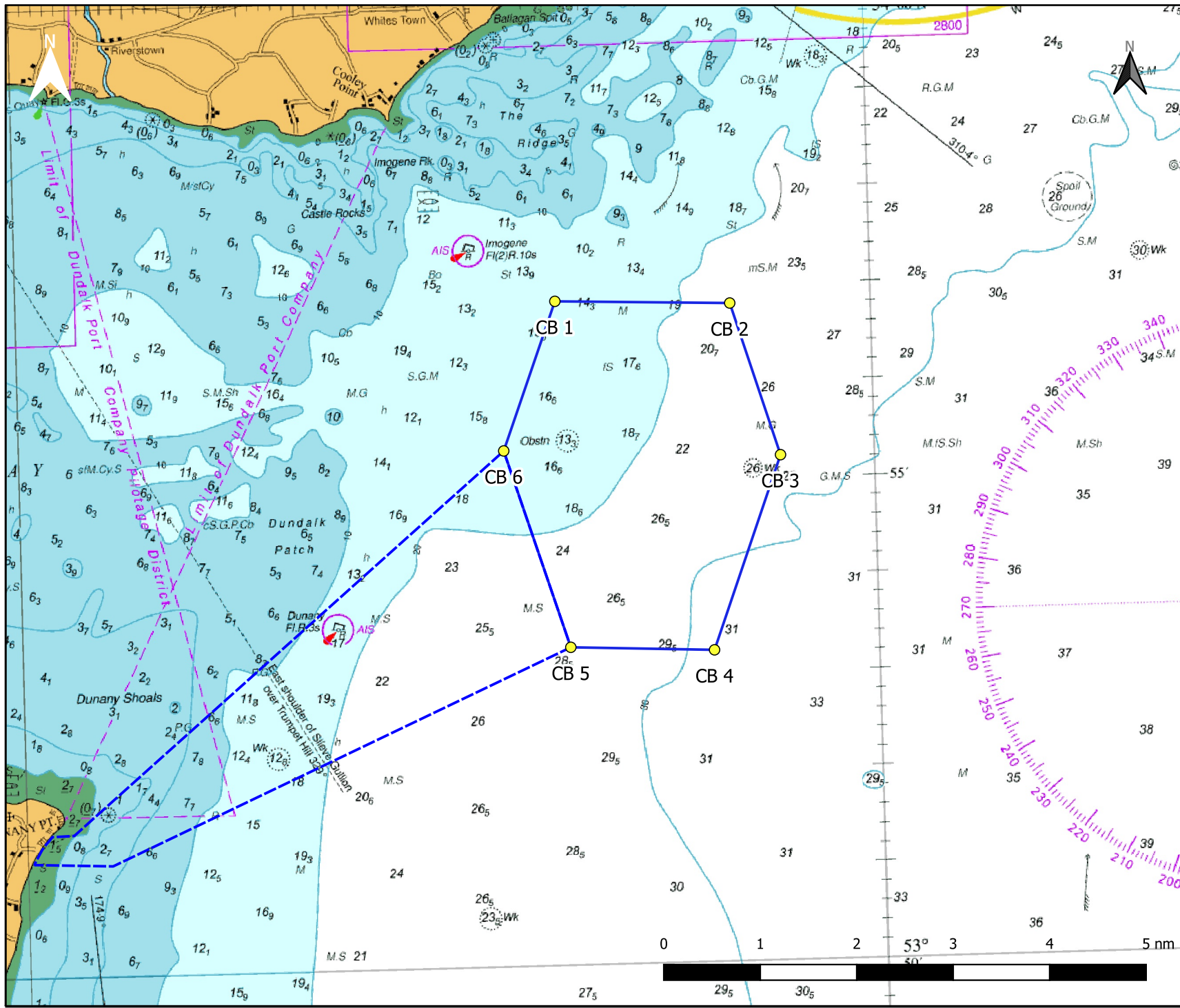
### 3.3 Construction phase

#### 3.3.1 Construction buoyage

The offshore wind farm area and offshore cable corridor will be marked as a construction area during the construction phase via the use of temporary construction buoyage. This will be a combination of cardinal marks and special marks as shown in Figure 3-1 and Table 3-1. Specifications of each buoy are:

- Focal plane of at least 3 m and nominal range of 5 nm;
- Minimum of 3 m in diameter at the waterline;
- Pillar shaped with a yellow 'X' shaped top mark;
- Light has the characteristics FI Y 5s;
- Category 2 availability requirement – 99.0%; and
- Radar reflector.





**Legend**

- Offshore Cable Corridor
- Offshore Wind Farm Area
- Construction Buoyage ●

Client

Project **Oriel Windfarm EIA**

Title **Figure 3-1: Construction Marking**

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**Table 3-1: Construction buoyage naming and coordinates.**

Coordinate system WTG ID	ITM - CRS: 2157		UTM-29N / CRS: 32629		WGS 84 / CRS: 4326	
	Easting	Northing	Easting	Northing	Longitude	Latitude
CB 1	725230	801514	690817	5981628	-6.09220	53.94780
CB 2	728589	801482	694175	5981643	-6.04100	53.94620
CB 3	729566	798570	695199	5978745	-6.02800	53.92000
CB 4	728298	794824	693978	5974981	-6.04800	53.88700
CB 5	725538	794872	691221	5974989	-6.09000	53.88800
CB 6	724250	798642	689880	5978739	-6.10800	53.92200

### 3.4 Operational and maintenance phase

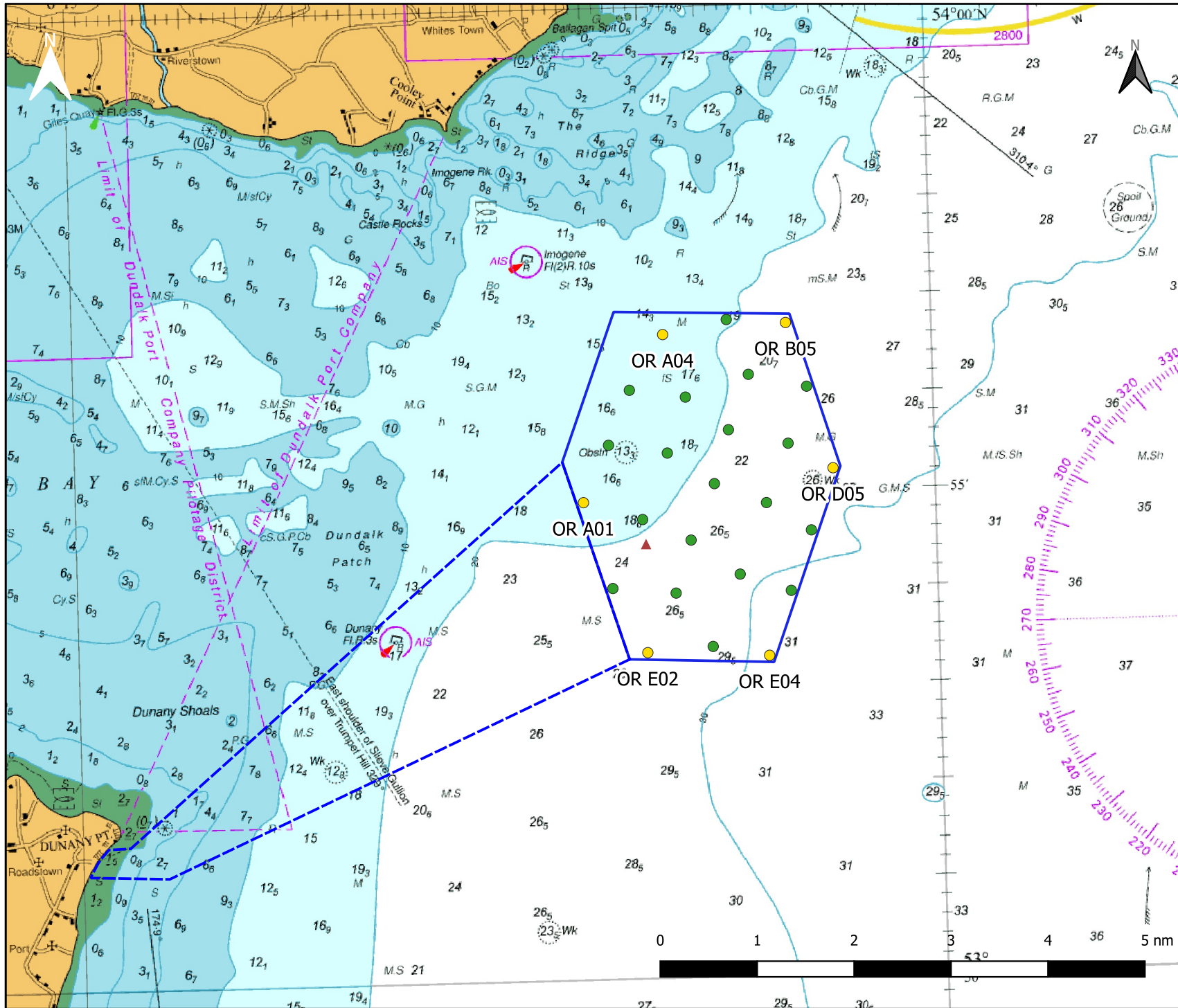
#### 3.4.1 Structure marking

The WTGs will be painted, marked and fitted with navigation lights in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) standards and more specifically as required by the CIL.

When in operation, all the WTGs will be marked with clearly visible and unique identification characters, which will be visible from all sides of the WTGs and comply with applicable international and local rules guidance and requirements. Each structure will be:

- Painted yellow all-round from the level of Highest Astronomical Tide (HAT) to 15 m, or the height of any Aid to Navigation if fitted, whichever is greater; and
- Marked with a unique alphanumeric identifier (“ID Boards”);

WTGs to be marked as Significant Peripheral Structures (SPS) located on the “corner” or other significant point on the periphery of a wind farm have been identified, shown in Figure 3-2 and identified in Table 3-2. Each individual SPS will be fitted with lights visible from all directions in the horizontal plane. The lights will be synchronised and display an IALA “special mark” characteristic (i.e. flashing yellow, with a range of not less than 5 nm). The lateral distance between such lit structures or the nearest SPS does not exceed 3 nm.



**Legend**

- Offshore Cable Corridor
- Offshore Wind Farm Area
- Wind Turbine
- Significant Peripheral Structure
- Offshore Substation

Client: **ORIEL WINDFARM**  
OFFSHORE RENEWABLE ENERGY

Project: **Oriel Wind Farm Project**

Title: **Figure 3-2: Operational Marking**

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**Table 3-2: Significant peripheral structure coordinates.**

Coordinate system		ITM - CRS: 2157		UTM-29N / CRS: 32629		WGS 84 / CRS: 4326	
WTG ID	Easting	Northing	Easting	Northing	Longitude	Latitude	
OR A1	724655	797868	690292	5977973	-6.10248	53.91517	
OR A4	726167	801082	691759	5981208	-6.07815	53.94367	
OR B5	728515	801314	694103	5981473	-6.04231	53.94517	
OR D5	729424	798537	695051	5978709	-6.02965	53.92001	
OR E1	725217	796227	690877	5976340	-6.09460	53.90029	
OR E3	727134	795120	692810	5975260	-6.06591	53.88989	

## ORIEL WIND FARM PROJECT – LIGHTING AND MARKING PLAN

# 4 AVIATION LIGHTING AND MARKING

This section sets out how the Project will be marked and lit to meet the requirements for aviation lighting and marking. The aviation lighting and marking scheme will be agreed with the IAA, IRCG and DoD, and has been designed to be in compliance with the relevant guidance presented in Section 1.3.

## 4.1 Impact on civil and military aviation

Volume 2B, chapter 14: Aviation, Military and Communications of the Environmental Impact Assessment Report (EIAR) identified creation of physical obstacles affecting air traffic as a potential impact. However, with the implementation of the measures included in the Project this impact was scoped out from further assessment. One of the measures included in the Project is the preparation and implementation of a LMP setting out specific requirements in terms of aviation lighting to be installed on the turbines. Other measures included in the Project (from volume 2B, chapter 14: Aviation, Military and Communications) relevant to the LMP are summarised in Table 4-1.

**Table 4-1 Measures included in the Project relevant to the LMP.**

Measures included in the Project	Justification
<b>Civilian and Military Aviation Interests</b>	
All SPS, to the highest point of the structure, will be fitted with high intensity warning lighting. Specific requirements are listed in IAA ASAM No: 018 (IAA., 2015).	To meet IAA requirements as listed in IAA ASAM No:18 (IAA., 2015) and to ensure appropriate lighting is in place to facilitate aeronautical safety.
Preparation and implementation of a LMP setting out specific requirements in terms of aviation lighting to be installed on the turbines. The LMP will be prepared in consultation with the IAA, DoD and IRCG.	To ensure appropriate lighting is in place to facilitate aeronautical safety.
The IAA will be informed of the locations, heights and lighting status of the wind turbines, including estimated and actual dates of construction and the maximum heights of any construction equipment to be used, prior to the start of construction, to allow inclusion on Aviation Charts and in the IAA Integrated Aeronautical Information Package (IAIP).	To comply with Offshore Renewable Energy Development Plan (OREDPP) (Department of Communications, Climate Action and Environment (DECC)., 2022) which requires the IAA to be notified of the construction and location of wind turbines.
During the operational phase, the Project operator will issue, as necessary, requests to the IAA to submit Aeronautical Information Circulars (AIC) in the event of any failure of aviation lighting. Any light which fails will be repaired or replaced as soon as is reasonably practicable. An alerting system for light failure will be put in place, such as remote monitoring or other suitable method agreeable to the IAA.	To comply with IAA ASAM No.18 (IAA., 2015) which contains the policy on actions in the event of the failure of aviation warning lights on offshore wind turbines listed in the IAA IAIP.
All structures > 90 m Above Mean Sea Level (AMSL) in height will be charted on aeronautical charts and reported to the IAA at least three months prior to construction, for input into the IAA's database of tall structures in Ireland.	An object which is higher than 90 m in height is considered to have significance for the <i>en route</i> operations of aircraft in Irish airspace.

## 4.2 Promulgation of information

Details of the Project will be promulgated to relevant aviation stakeholders in advance of, and during, construction, and also during the operational phase where appropriate as required. Stakeholders will also be informed when construction is complete. The relevant aviation stakeholders to be informed include but are not limited to:

- DoD;
- IAA; and
- IRCG.

## ORIEL WIND FARM PROJECT – LIGHTING AND MARKING PLAN

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### 4.3 Statutory sanction

As required by ASAM No: 018 Issue 2, the Project will inform IAA of the locations, heights and lighting status of the wind turbines, including estimated and actual dates of construction and the maximum heights of any construction equipment to be used, prior to the start of construction, in order to allow inclusion on aviation charts and in the IAA IAIP.

### 4.4 Construction phase

At least three months in advance of the erection of the structures the following information will be supplied to the IAA for promulgation in a manner considered appropriate by the Authority:

- Positional data representing the estimated position of each machine or structure to be erected. The geodetic datum to which all obstructions will be referred is the World Geodetic System of 1984 (WGS-84). Co-ordinates will be provided in degrees, minutes, seconds and decimals of a second, as appropriate;
- The maximum elevation of each structure in feet and metres;
- Proposed lighting details for each structure;
- Proposed marking details for each structure;
- Whether it is proposed that a Radar Enhancer / Transponder / Reflector or Radar Automatic Identification System (AIS) be fitted;
- Minimum and maximum spacing between structures;
- Planned earliest date of erection; and
- Any other information considered relevant for air navigation.

No specific aviation lighting or marking will be implemented during the construction phase. As outlined in Table 4-1, the Applicant will undertake promulgation of information to the relevant aviation authorities and stakeholders prior to and during construction.

The lighting and marking requirements in the interim construction phase, as temporary lighting and marking transitions to the operational lighting and marking scheme, will be agreed with IAA as the construction programme is developed.

There is an IAA requirement for all structures (temporary or otherwise) of 90 m or more to be charted on aeronautical charts. WTG locations will be reported to the IAA at least three months prior to construction, for input into the IAA's database of tall structures in Ireland. As per IAA requirements, the lighting status of the WTGs and the estimated start/end dates for construction will be provided together with the estimate of when the WTGs are scheduled to be removed.

### 4.5 Operational phase

Throughout the lifetime of the Project, aids to air navigation will be provided in accordance with the requirements of the IAA.

The IAA ASAM requirements for lighting specifications differ significantly to those required by the UK CAA. It is anticipated that, during consultation with key statutory stakeholders, it will be agreed that guidance should be taken from UK requirements for best practice; in particular, MGN 654. The lighting and marking requirements will be finalised when a final turbine layout is established and agreed with the IAA, IRCG and DoD.

No marking requirements to protect air navigation safety are contained in the IAA ASAM No: 18, Issue 2; however, the MCA provides UK requirements in MGN 654 Annex 5 as summarised in the following sections.



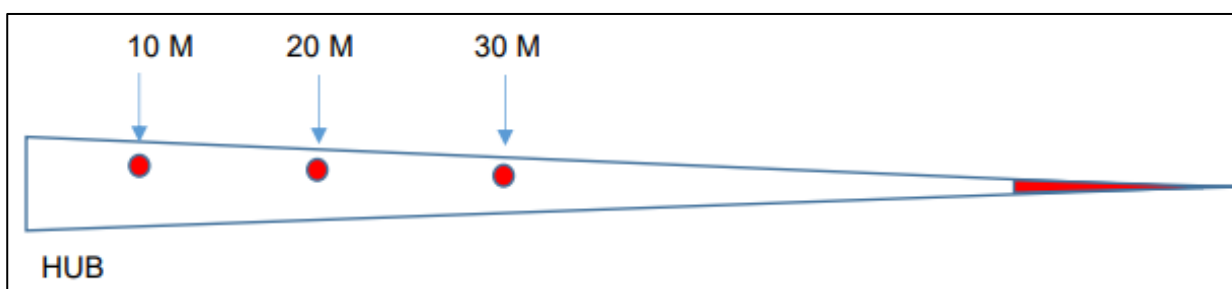
## ORIEL WIND FARM PROJECT – LIGHTING AND MARKING PLAN

### 4.5.1 Blade hover circles

WTG blades need to be marked to provide SAR helicopter pilots with a hover reference point when hovering over a nacelle during a rescue. Three marks are required in red on each WTG blade. The marks should have a minimum diameter of at least 600 mm and be positioned on both faces of the blades at distances of 10 m, 20 m and 30 m from the blade root (see Figure 2-1).

### 4.5.2 Blade tips

Blade tips must be painted red for at least the final 2% of their length as shown in Figure 4-1, again, as an aid to helicopter pilots. However, if lightning protection systems are to be included in the blade tips, the lightning receptors may be left unmarked.



**Figure 4-1: Blade hover reference and tip marks.**

### 4.5.3 Nacelle roof

Individual ID numbers are also to be painted on the nacelle roof so that SAR helicopters and/or other low flying aircraft can locate and/or reference a WTG visually. ID numbers should be recognisable from an aircraft flying 500 ft (152 m) above the highest part of the structure (i.e. the blades at their vertical point). Such numbers should be as large as practicable but not less than 1.5 m in height and of proportionate width. ID numbers should be placed on the roof in a logical manner so that the OREI can be easily distinguished however there is no requirement for them to be lit.

### 4.5.4 Helihoist guidance

No requirements for helihoist lighting are contained in the IAA ASAM. In lieu of Irish specific requirements, the UK requirements given by the CAA in CAP 437 are listed below.

Low-intensity green lights are required to be fitted to the WTG nacelle to indicate the status of the WTG for hoisting operations to helicopter pilots. The status of the WTG will be indicated as follows:

- Steady green will indicate when the WTG has been made safe for hoist operations;
- Flashing green (120 flashes per minute (fpm)) will indicate that the WTG is preparing for hoist operations; and
- Extinguished lights will indicate that it is not currently safe to perform hoisting operations.

For the helihoist deck, railings shall be marked in red for easy identification of the boundaries, whilst the hoist zone shall be marked in yellow and the safe zone marked in green.

## ORIEL WIND FARM PROJECT – LIGHTING AND MARKING PLAN

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### 4.5.5 Radar enhancers required to protect air navigation safety

The IAA ASAM requires that SPS WTGs must be fitted with radar reflectors in order to protect air navigation safety. Consultation is required with the IAA to define specific requirements for the radar reflectors when the final turbine layout is established.

### 4.5.6 Aviation lighting requirements

The lighting required to protect air navigation will be the lighting specified to protect marine navigation safety, supplemented as follows:

All SPS (see Figure 3-2), of height  $\geq 90$  m AMSL, will be fitted with high intensity warning lighting meeting the following requirements:

- The lighting must be mounted on the highest point practicable of the fixed structure;
- Be in accordance with the International Civil Aviation Organisation (ICAO) Annex 14 standards, on a H24 basis, for High Intensity Type A lighting:
  - Colour white with a flash rate of 40~60 fpm);
  - An effective intensity, with background luminance above 500 cd/m<sup>2</sup>, of 200,000 cd  $\pm$  25%;
  - An effective intensity, with background luminance 50~500 cd/m<sup>2</sup>, of 20,000 cd  $\pm$  25%;
  - An effective intensity, with background luminance below 50 cd/m<sup>2</sup>, of at least 2,000 cd;
  - Light fittings will be fully cut off so that practically no light will be emitted below the horizontal, or as otherwise agreed with the IAA;
  - All lights across the wind farm should flash in synchronisation and reductions in light intensity should occur simultaneously, if practicable; and
  - Be visible through 360° in azimuth.
- Any light which fails will be repaired or replaced as soon as is reasonably practicable. An alerting system for light failure will be put in place, such as remote monitoring or other suitable method agreeable to the IAA.

## ORIEL WIND FARM PROJECT – LIGHTING AND MARKING PLAN

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### References

CAA (2021) Standards for Offshore Helicopter Landing Areas. Available at: [Standards for offshore helicopter landing areas \(caa.co.uk\)](https://www.caa.co.uk/standards-for-offshore-helicopter-landing-areas)

DECC (2022) Offshore Renewable Energy Development Plan II: Strategic Environmental Assessment - Scoping Report. Available at <https://www.gov.ie/pdf/?file=https://assets.gov.ie/231787/776d40e2-e734-42dd-b951-a4f12d7ede8a.pdf#page=null>. Accessed 20/02/2023.

IAA ASAM No: 018, Issue 2 (2015) Guidance Material on Off-Shore Wind Farms. Available at: [https://www.iaa.ie/docs/default-source/publications/advisory-memoranda/aeronautical-services-advisory-memoranda-\(asam\)/guidance-material-on-off-shore-wind-farms.pdf?sfvrsn=5aad0df3\\_6](https://www.iaa.ie/docs/default-source/publications/advisory-memoranda/aeronautical-services-advisory-memoranda-(asam)/guidance-material-on-off-shore-wind-farms.pdf?sfvrsn=5aad0df3_6)